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United States Naval Medical Bulletin

PUBLISHED *for the* INFORMATION OF MEDICAL DEPARTMENT *of the* NAVY

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Washington D. C.

Vol. XXIV JANUARY, 1926 No. 1

UNITED STATES NAVAL MEDICAL BULLETIN

Published Quarterly for the Information of the Medical Department of the Navy

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THE BUREAU OF MEDICINE AND SURGERY
NAVY DEPARTMENT

DIVISION OF PLANNING AND PUBLICATIONS
CAPTAIN D. N. CARPENTER, MEDICAL CORPS, U. S. NAVY
IN CHARGE

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Edited by

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U. S. NAVY

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1925

NAVY DEPARTMENT,
Washington, March 20, 1907.

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
Acting Secretary.

Owing to the exhaustion of certain numbers of the BULLETIN and the frequent demands from libraries, etc., for copies to complete their files, the return of any of the following issues will be greatly appreciated:

Volume VII, No. 2, April, 1913.
Volume VIII, No. 1, January, 1914.
Volume VIII, No. 3, July, 1914.
Volume VIII, No. 4, October, 1914.
Volume X, No. 1, January, 1916.
Volume XI, No. 1, January, 1917.
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PREFACE

The UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April, 1907, as a means of supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, reports from various sources, historical essays, notes and comments on topics of medical interest, and reviews, or notices of the latest published medical books.

The bureau extends an invitation to all medical officers to prepare and forward, with a view to publication, contributions on subjects of interest to naval medical officers.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of commendation to authors of papers of outstanding merit and will recommend that copies of such letters be made a part of the official records of the officers concerned.

The bureau does not necessarily undertake to indorse all views or opinions which may be expressed in the pages of this publication.

E. R. STITT,
Surgeon General, United States Navy.

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Contributions to the BULLETIN should be typewritten, ***double spaced***, on plain paper, and should have wide margins. Fasteners which will not tear the paper when removed should be used. Nothing should be written in the manuscript which is not intended for publication. For example, addresses, dates, etc., not a part of the article, require deletion by the editor. The BULLETIN endeavors to follow a uniform style in headings and captions, and the editor can be spared much time and trouble, and unnecessary changes in manuscript can be obviated, if authors will follow in these particulars the practice of recent issues.

The greatest accuracy and fullness should be employed in all citations, as it has sometimes been necessary to decline articles otherwise desirable because it was impossible for the editor to understand or verify references, quotations, etc. The frequency of gross errors in orthography in many contributions is conclusive evidence that authors often fail to read over their manuscripts after they have been typewritten.

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U. S. NAVAL MEDICAL BULLETIN

VOL. XXIV JANUARY, 1926 No. 1

SPECIAL ARTICLES

CONTRIBUTIONS OF THE MEDICAL CORPS, UNITED STATES NAVY, TO AMERICAN MEDICINE [1]

By E. R. STITT, Rear Admiral, Medical Corps, United States Navy

In the message from your secretary general requesting that a paper be read at this convocation it was suggested that the subject be: "Contributions of the Medical Corps, United States Navy, to American Medicine." This seemed a very broad subject and one which, if discussed at length, would require a much longer time to be handled properly than the 20 minutes allotted. Before proceeding to this discussion it seems proper to give you a slight understanding of the ordinary duties of the naval medical officer, the work he does in his daily round, and of the benefits that are derived from this work, both by the Nation and by American medicine, since whatever benefits the people of the Nation in a physical way must be a contribution to medicine.

Before the year 1842 the Bureau of Medicine and Surgery did not exist as such, and the duties of naval medical officers were not well defined. Their status was indefinite. They were really civilians within a military organization but not part of it. Their duties consisted in caring for the sick and injured on board ship and in being ready at all times to care for the wounded during and after an engagement. Naturally their contact with their associates on board ship was intimate, and this, together with the fact that they themselves were forced to live under the very adverse conditions that prevailed on the wooden sailing ships of the old type, caused their efforts to be directed to ameliorating these conditions to as great an extent as lay within their power. It was essential that the men be kept "fit to fight." To accomplish this it was necessary that life on board

[1] Read before the American College of Physicians, Washington, D. C., March 12, 1925. Reprinted from Annals of Clinical Medicine, Vol. III, No. 12, June, 1925, by permission of the publishers, Williams & Wilkens, Baltimore, Md.

ship should be made as nearly normal as possible. Thus much time and thought were given to the problems pertaining to ventilation, heating, lighting, and bathing, as well as to the matter of a proper dietary on board ship. Much of our modern comfort of living, on shore as well as on the sea, to say nothing of the improved conditions under which our factory employees labor, is due to the suggestions made and devices utilized by these early pioneers in hygiene and preventive medicine whose aim was, as is also the aim of the present-day naval medical officer, to keep the men at the guns.

The Bureau of Medicine and Surgery was one of the five bureaus of the Navy Department established by the act of August 31, 1842. Regulations then issued defined for the first time the duties of the bureau, which was charged with responsibility in all matters pertaining to the health of the naval personnel. Summing up these duties, the regulations state:

> * * * It shall safeguard the personnel by the employment of the best methods of hygiene and sanitation, both afloat and ashore, with a view to maintaining the highest possible percentage of the personnel ready for service at all times. It shall adopt for use all such devices or procedures as may be developed in the sciences of medicine and surgery which will in any way tend to an increase in military efficiency.

Saying that the Bureau of Medicine and Surgery is charged with these duties is equivalent to saying that these are the duties which must be performed by the individual medical officer. When their scope and extent is considered it is very evident that the time required for their proper performance leaves little opportunity for the average, conscientious medical officer of the Navy to engage in research work or to attempt to develop new methods of diagnosis or treatment of disease. It is his duty to know of the advances made by others and to apply these in such a way that the greatest benefit may derive to those under his care in the naval service and to those native population wards of our Government for whose physical welfare he is responsible.

By carrying out these duties the naval medical officer has assisted in making the Navy of to-day one of the healthiest bodies of young men in the world as well as an almost ideal training ground for the youth of the Nation.

Not all of the men who enter the naval service remain therein, and those who go out after receiving the benefits of its training spread far and wide the gospel of cleanliness and healthy living.

In the final analysis, the disease incidence in the Navy is dependent upon that in the civil population. The Navy in safeguarding the health of its personnel can not but influence the health of the Nation, inasmuch as the men trained in personal and general hygiene sooner or later all return to civil life and disseminate through the

United States the knowledge gained in the Navy as to how to keep well.

Herein lies the greatest benefit conferred upon the Nation by the officers of the Medical Corps of the United States Navy and this is their great contribution to American medicine.

Another very important service is in connection with providing opportunities for the evaluation of problems in preventive medicine. In the Army and Navy we have a definite complement serving under varying but ascertainable environments, so that the results of public-health methods can be weighed with an exactness not possible in civilian communities. The studies made on the physical defects and disease incidence of the men serving in the Army and Navy during

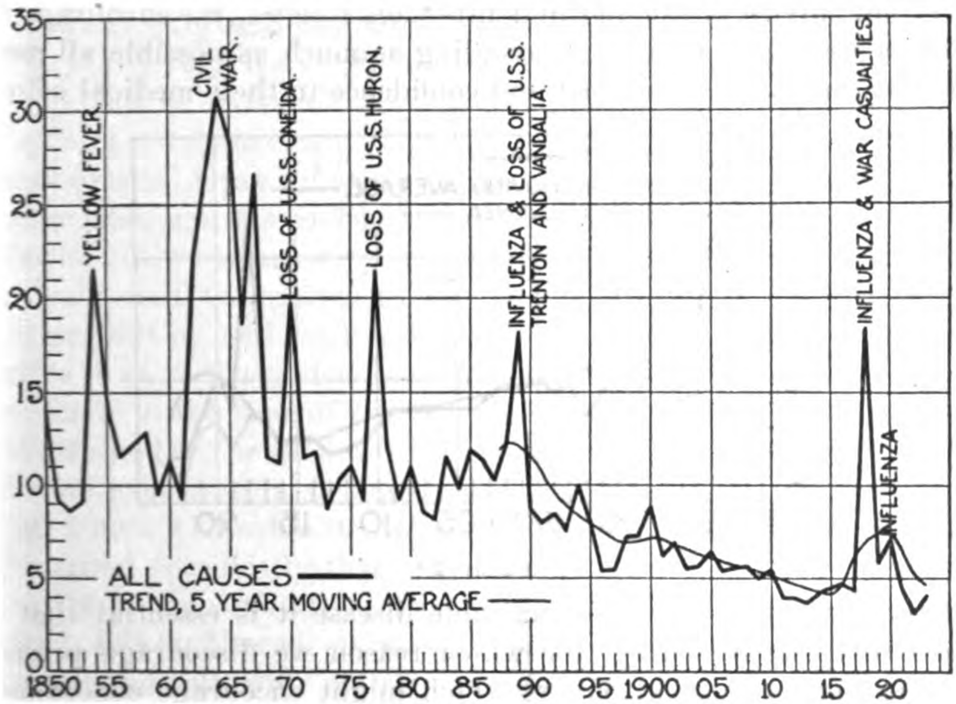

CHART 1

the World War are recognized as the most valuable contributions to the future health and welfare of the Nation that have ever been published. The Army and Navy, as well as the Nation, were fortunate during that period in having the services of the greatest men in the medical profession, whose patriotism and talents made these statistics a contribution of inestimable value to future generations. Although returned to their practices or professorial chairs, they appreciate the opportunities in the hands of the medical officers of the regular establishments and give us their approval and encouragement.

At the present time I consider the control of venereal diseases our greatest problem, as approximately 25 per cent of the damage done the Navy by diseases is from this cause.

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We now have a board of line officers associated with us in the application of measures for the control of venereal diseases which we believe to be ethically correct and scientifically sound.

The environmental influences in many of the cities and towns from which our sailors come are so bad, from a social-hygiene standpoint, that we can hope for little result from our instruction. For the success of an educational program, explaining the dangers of venereal diseases and inculcating the necessity for continence, the start should be made in the home and in the schools. In the Navy we try to make the man think of the future, pointing out the effect of disease on his advancement and the dire consequences which may follow in case of marriage.

If our advice is ignored and infection follows, we encourage the men to seek early treatment, avoiding as much as possible all measures tending to weaken trust and confidence in their medical officers.

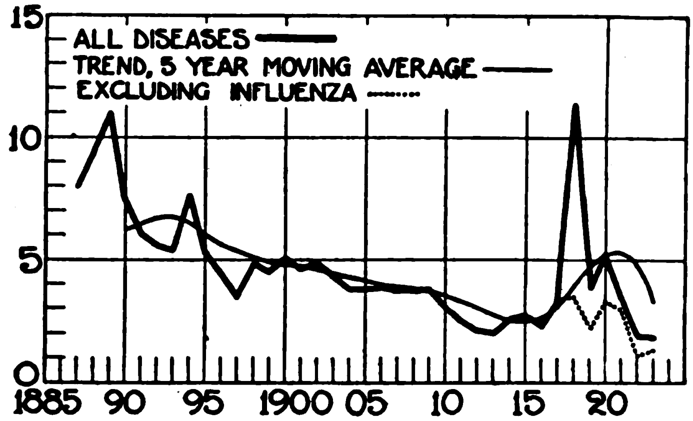

CHART 2 *

In the control of any communicable disease it is essential that we have complete reporting, for which reason we discourage pressure on the men or medical officers which might encourage concealment of disease. Only concealment of disease and failure to seek early treatment should be punishable.

We have spared neither effort nor money in the application of chemical prophylaxis, constantly seeking new formulas which may be more effective, but so far such measures have not given us the results we hoped for.

Living apart from the companionship of women makes more strong the longing for such association, and we recognize the help that can be given us by churches and other organizations in arranging entertainments where the enlisted men can meet young women of the right type and thus form desirable acquaintanceships.

Recognizing the importance of public opinion, we try to support the influence of the man of character and to put an end to the per-

* Estimating the death rate from *disease only*, as distinct from the death rate from *all causes*, was not done before 1885.

nicious activities of the man of loose morals. In our statistical reports and supporting analyses we are trying to assist in the solution of this most difficult problem.

Another study that we are conducting, which has aroused great interest among the psychologists, deals with the utilization of recruit material found intellectually deficient by psychometric tests. Such individuals, provided the psychiatrist does not recommend their immediate discharge, are kept under close observation by company commanders and their vocational response from week to week noted and recorded. This problem, like the venereal-disease one, requires hearty cooperation between the line officer and the medical officer. I often wonder whether there is as close coordination between medical and lay efforts in community welfare as such activities demand.

The ready response of the men of the Army and Navy to hazard their health or lives, when by so doing they may benefit others, is something we appreciate. The heroism of the men of the Hospital Corps of the Army who made possible the epochal discoveries of Walter Reed and his colleagues are well known to all of you.

In the Navy we are very proud of the men of our enlisted force who subjected themselves to the efforts of Commander Rosenau, Surgeon McCoy, and their colleagues of the Navy and Public Health Service to solve the epidemiology of influenza. The first experiments were made at the time of the devastating epidemic of 1918–19, when death stalked in the shadow of the disease.

In the experiments at Boston and San Francisco there were 118 enlisted men who submitted themselves to experimentation after being warned specifically that they were risking their lives. Various attempts to transmit the disease by inoculating pure cultures, and filtered and unfiltered secretions from typical cases of influenza, were carried out with entirely negative results. The well-known abilities of those who conducted these researches attest the thoroughness with which the experiments were planned and executed, and these tests established facts which could have been determined in no other way.

At the time I entered the Navy, 36 years ago, many of our senior officers had served in the period when the American clipper ships held sway. It is to be regretted that so few of these men published their experiences encountered in out-of-the-way ports of every part of the world. Their willingness to give to native peoples the advantages of medical skill must have made friends for American medicine and American institutions. Only recently I was reading of some of the remarkable operations done by Surg. Ninian Pinkney in his cruises in South American waters. So well known was his surgical skill that when his ship would visit a port he was called upon to perform operations beyond the capabilities of the local

surgeons. It may interest you to know that later on he was in charge of the first naval hospital ship of the Civil War, the *Red Rover*, and the records of his operations on that ship explain the fame he had acquired in former years. His work must have added to the prestige of American medicine in South America.

When revolutions or civil wars take place in another country it is usual to send a man-of-war to give assistance to such Americans as may be living in that country. In this way many opportunities to help the wounded soldiers offer themselves to our medical officers. Frequently the burden placed on the local surgeons is so vast that were it not for the help of the surgeons from visiting warships many of the wounded would die from lack of attention. In giving such service we often have the opportunity to make observations of value to medical science.

In 1891, while ashore in Valparaiso treating the wounded of the battles of Placilla and Concon, I was able to make notes on the differences between wounds made by small-caliber bullets and those caused by lead bullets fired from older type rifles. This was the first use of the modern rifle in warfare and I believe my article was the first to report the results.

In visiting foreign ports the naval doctor is usually extended many courtesies by the medical officials of the country. In this way he is able to observe many exotic diseases, the characteristics of which he may later describe to those not having the opportunity to see such diseases. Occasionally men of the ship's crew may contract these diseases and in this way bring them to the United States. I remember our bringing back a number of cases of Malta fever when the *Chicago*, in 1894, returned home from a cruise in the Mediterranean. This was before we knew of the importance of boiling the goat's milk. These cases, with their irregular fever, joint and nerve pains, and history of continuation for many months, puzzled the best diagnosticians of our New York clinics and convinced them of the unreliability of sailors' stories.

With the sinking of the U. S. S. *Maine* in Habana Harbor on February 15, 1918, a new era opened for the Medical Corps of the Navy. It was seen that war was imminent and steps were immediately taken to solve any problems that might arise. Even then, however, it was not fully realized that the war would result in our becoming a world power with widely scattered colonial possessions. Nevertheless, when the war ended, this is what we found ourselves to be. With the acquisition of territory we acquired dependent wards of the Nation and it immediately became our paramount duty to see that these people did not suffer as a result of the change in their status but were given the benefit of all our knowledge and experience in government and in humanitarian work. Not the least of these

duties were those of introducing modern ideas of medicine and teaching the people so to live that their own health would be conserved to the greatest possible degree and so they would no longer be a menace to those who would be forced to come in contact with them. Thus the naval medical officer was introduced to the problems of tropical diseases and of preventive medicine on a far larger scale than had been his lot hitherto.

Among the possessions acquired by the United States as a result of the Spanish-American War is the island of Guam, situated in the Pacific Ocean about 1,200 miles east of the Philippines. On August 7, 1899, the U. S. S. *Yosemite* arrived in the harbor of Agana and established the naval station. Guam, from the time it became an American possession, has been governed by an officer of the United States Navy and all of the medical work has been done by naval medical officers. Among the first improvements made were the establishment of a hospital, the laying of sewers, and the installation of an evaporating plant which would insure an abundant supply of potable water. Medical officers immediately began a systematic study of disease conditions among the natives. It is interesting to note that at the beginning of this study a medical officer wrote:

> Syphilis, especially in the tertiary forms, is very common in Guam. Its ravages have been terrible. People without noses, with lifeless gums, and gigantic loathsome ulcers are not unusual. * * * The natives think little of the disease and do not take any form of treatment.

Typhoid fever was epidemic upon the island and was peculiarly fatal in its results. As evidence of the prompt and strenuous efforts made by the medical officers early in Guam, the Surgeon-General's Report for 1901 tells us that the inhabitants of the island were proceeding with the establishment of a civil hospital and showing themselves desirous to conform to the customs of other communities in this respect. Already he was able to report that typhoid fever on the island had almost disappeared in consequence of an improvement in the water supply. A small hospital was soon established, followed shortly by another which increased the facilities for hospital care to 100 beds, capable of expansion to 200.

In connection with these hospitals are training schools for native nurses. Young native women have been and are being trained under the direction of naval medical officers and navy nurses and are proving themselves invaluable as they replace the ignorant, incompetent midwives who were formerly the only nurses available.

It was not until 1904 that doubt seems to have been cast upon the statement that syphilis was prevalent in Guam. In that year Surg. J. F. Leys recognized that the condition was not syphilis, described it, and proposed the name rhino-pharyngitis mutilans. The Spanish.

on account of the peculiar muffled character of the voice which accompanies it, had called this disease "gangosa," and this is the name by which it is commonly known at present.

It is generally considered that it is either an independent disease or a sequel of yaws. There are none of the usual signs of acquired or congenital syphilis among the natives of Guam. In spite of this fact, Surg. E. H. Odell, in 1910 and 1911, instituted antiluetic treatment. The result was complete healing of the ulcers in all cases treated. Since the introduction of salvarsan and neosalvarsan these drugs have been used with marked success and now gangosa is a conquered disease in the island of Guam. This does not prove that the disease is syphilitic in origin, as it is well known that yaws also responds well to the arsenicals, and gangosa is now regarded as tertiary yaws.

Through interest in the welfare of the people and through long study of the disease, the medical officers of the Navy have found the cure for this most horrible and disfiguring affliction of our wards, the Chamorros. That the disease has been really conquered is evidenced by the report of Surg. L. W. Johnson, who, in 1916, wrote:

> Guam has several hundred persons who show the residual effects of old gangosa lesions, but the treatment by salvarsan and mercury has been so successful that active cases are now very rare and a medical officer may serve his tour of duty here without seeing the disease in its acute manifestations.

While the conquering of gangosa is the outstanding feature of the naval medical work in Guam, attention to other disease conditions has not been lacking. Leprosy, epidemic asthma (guha), yaws, dengue, malaria, filariasis, as well as diseases due to intestinal parasites (and these are legion), have been studied. The result is that this one of our possessions from being a hotbed of disease has become, for the natives at least, a health resort. Of course, for a white man of the Temperate Zones, no tropical country can be made into a place suitable for long residence because of climatic conditions over which even modern medicine as applied by naval medical officers can have no control.

In 1839 Commodore Charles Wilkes surveyed the Samoan group of islands and negotiated an agreement with the principal chiefs by which the interests of the natives and of the traders and whalers who visited the islands were safeguarded. Since that time the natives have been friendly toward the United States. As in the case of Guam, since its acquisition by the United States, American Samoa has been governed by naval governors and its medical problems have been those of naval medical officers.

The diseases prevalent among the Samoans were elephantiasis, framboesia (yaws), and various forms of ringworm, particularly

tinea imbricata. Because of uncleanliness, a large proportion of the children suffered from diseases of the eyes. As in Guam, the first essential sanitary work undertaken concerned cleanliness, drainage, and the disposal of sewage. No problem of water supply had to be met, as Samoa is a wet country, the average annual rainfall being about 165 inches, and the watershed is steep and uninhabited.

That not all the changes occasioned by the coming of the white man to these islands were beneficial to the natives is shown by the report of Surgeon Spear, who was on duty in Samoa in 1902 and 1903. He says:

> The natives are beginning to wear white men's clothes, much to the detriment of their health. The climate is essentially a wet one. In former times a native would rub a little coconut oil on his skin and go out into the rain, and when he reached shelter there was nothing to dry but his "lava-lava" or breechcloth. The same native now goes out into the rain, his modern clothes become wet, and, before he realizes it, he becomes chilled through, for the rain here is always from 6° to 10° colder than the atmosphere Pulmonary affections such as pneumonia and bronchitis, naturally follow.

The naval medical officer was in no way responsible for this change, but, nevertheless, it added to the difficulties which were his in looking after the physical welfare of the people. The usual treatment for pneumonia was as follows: The patient sat up continually; ate all sorts of food and drank all sorts of decoctions to drive out the devils, the number of devils present being determined by the severity of the pain. He got up and walked about as long as he was able. When he could no longer walk he would lie down and cover his head to keep out all air. With the coming of the naval medical officer this was soon changed, modern medical treatment was instituted, and the usual results followed.

Within one year after our occupation of the islands the entire native population had been vaccinated against smallpox.

In 1906 Surgeon Fauntleroy attempted the surgical treatment of elephantiasis of the scrotum on a large scale. He performed in that year 149 operations for this condition, with but one death and with complete success in all other cases. The masses removed weighed from 10 to 85 pounds.

In 1922 an examination to determine the prevalence of hookworm infestation was made. Twelve hundred natives were examined and 87.6 per cent were found to be infested with intestinal parasites of some sort, 95 per cent of these showing hookworm.

Also in this same year a survey showed that there was a great number of cases of yaws among the natives. Immediately a campaign to eradicate the disease was instituted. Salvarsan was administered on a large scale and steps were taken to destroy the flies,

these being the principal agents in the transmission of yaws in Samoa.

The Navy Nurse Corps has done and is doing splendid work in Samoa, as well as in Guam and the Virgin Islands, in training native nurses and this work has had far-reaching effect upon the welfare of the people, particularly in regard to infant mortality.

Similar as well as other new problems were presented to the naval medical officer by the purchase of the Virgin Islands by the United States in 1917. It is true that the native population of these islands was much further advanced in sanitary knowledge than were the people of Guam and Samoa, thanks to their close proximity to other civilized countries and because for so many years they had been ruled by representatives of the Danish Government, who were not lacking in solicitude for their welfare. At the time of our occupation no measures to exterminate mosquitoes were in force, sewage disposal was primitive to an extreme, and the water supply was insanitary and inadequate for health. The people were underfed, owing to a lack of knowledge of the value of easily obtained foods. Pellagra was conspicuously present, as was also typhoid fever. Surg. C. S. Butler was the first senior medical officer sent to the islands, and it is largely due to his efforts that such tremendous success has crowned the work of our officers in improving the health conditions among the people of the Virgin Islands of the United States.

Under the Danes the people had been protected by vaccination against smallpox, but the lack of care in the disposal of sewage and the handling of milk had resulted in the constant and widespread presence of typhoid fever. In August, 1918, after an epidemic in St. Thomas, vaccination against this disease of all persons between the ages of 5 and 45 years was performed. Since then there have been no cases of typhoid fever reported.

Realizing that pellagra is a food-deficiency disease, it was difficult for our medical officers to understand why it should be so prevalent among people surrounded by an abundance of suitable food such as eggs, chicken, meat, milk, and edible fish. It was found that on account of the extreme poverty of the natives they subsisted largely on the two cheapest foods available—corn meal and sugar. Occasionally a little salted fish was added. The pellagra victims were hospitalized and treated by the addition of proper foods to their diet. The cured patients upon leaving the hospital spread the news, and thus the pellagra problem was solved.

The Virgin Islands are unique in that a health record is kept of the entire native population. It is easily seen that this is of inestimable value, not only to the medical officers who are making clinical and epidemiological studies but to the natives as well.

FIG. 1.—U. S. NAVAL HOSPITAL, GUAM

FIG. 2.—GANGASA PATIENTS, NAVAL HOSPITAL, GUAM

FIG. 3.—THE NAVY NURSE INSTRUCTS THE SAMOAN NURSES IN THE NATIVE CLINICS

FIG. 4.—CHIEF PHARMACIST'S MATE INSPECTING PREMISES FOR MOSQUITO LARVÆ IN ST. THOMAS, VIRGIN ISLANDS

FIG. 5.—THE DISTRICT NURSE HOLDS WEEKLY CLINICS IN THE VILLAGES OF ST. CROIX, VIRGIN ISLANDS

A new ambulance has recently replaced the old Ford

FIG. 6.—ELEPHANTIASIS IN THE VIRGIN ISLANDS

Other problems being studied and solved by our officers on duty in these islands are those of the prevention of malaria, filariasis, dengue, leprosy, and, especially, the venereal diseases.

In Haiti our medical officers are now carrying out a public-health program which will not only redound to the credit of American medicine but will prove the greatest factor in the establishment of good relations between the Haitians and ourselves. In Haiti the same conditions exist as are found in many of the ports of the world where the work of the medical missionary has been so helpful to the recognition of American good will. During the French régime hospitals did exist, but where they were or the rôle they played we do not know, so complete was the white man's extermination after 1804.

When we first took charge of the health work we found an institution in Port au Prince which had neither hospital facilities nor opportunities for treatment of its patients. Now we have there a well-administered 500-bed hospital which patients enter to be cured instead of to die. Not only is the treatment modern but we are training Haitian physicians in the art of medicine and conducting a school for nurses which will provide health missionaries to guide public opinion in all parts of the Republic. There are 10 other hospitals being operated in different Provinces, and along with hospital and dispensary service go various sanitary measures, such as mosquito control, vaccination against smallpox, and community health activities. In response to the request of the high commissioner and the Bureau of Medicine and Surgery, the Rockefeller Foundation has recently decided to enter this wonderful field of opportunity. In addition to our hospital, public health, and educational activities, we plan to establish research work.

As you all know, we withdrew from participation in the government of Santo Domingo a few months ago, after having carried on health activities in that Republic similar to those we are still conducting in Haiti. It is most gratifying to learn from outside sources that the demonstration of the value of modern medicine, conducted by our naval medical officers, has made a deep and, we hope, lasting impression on the people of that country.

It is an interesting but not well-known fact that the naval medical officers with the marine expeditionary force sent to the Isthmus of Panama in 1903 were the first to find that the dread Chagres fever was really either malaria or dengue and could be controlled. They also first reported the leucopenia and relative lymphocytosis so characteristic of dengue. They demonstrated that the cachexia so prevalent among the people, particularly the Colombians, was due to hook-

worm, and they conducted a malaria survey which was a great assistance to General Gorgas and his coworkers in their later magnificent work.

Our navy yards are usually situated in the poorer sections of our cities and their surroundings have contributed largely to the incidence of disease among the personnel, particularly among the enlisted men. For years naval medical officers have fought to improve these conditions, and upon our entry into the World War opportunity presented itself when, as an emergency measure, supervision over these districts was granted to the naval authorities. The result has been a "clean-up," with consequent improvement in the health of our own personnel as well as in that of the residents of the cities concerned.

Through work on submarines and through studying the effects upon men of explosions on board ship our medical officers have advanced the knowledge of the effects of breathing poor air and deleterious gases.

The Navy was among the pioneers in the use, on a large scale, of salvarsan and neosalvarsan, and its voluminous reports have been of assistance in arriving at a true estimate of the value and safety of these drugs in syphilis.

The Naval Medical School is training young doctors in laboratory procedures, tropical medicine, and hygiene, and is making experts whose value to American medicine will increase as time goes on.

BLACK TONGUE

By C. R. Wells, Lieutenant, Dental Corps, United States Navy, and G. W. Cooper, Lieutenant (Junior Grade), Medical Corps, United States Navy

Introduction

Black tongue of dogs is a formidable, systemic disease recognized as simulating human pellagra in many respects and of not uncommon frequency of occurrence. As may be guessed, there is not even the slightest relationship to the so-called human black tongue. In Public Health Report, volume 38, No. 46, November 16, 1923, Goldberger, Tanner, and Sayre give the necropsy findings of a case of black tongue of dogs and point out that this disease is probably identical with the experimentally produced pellagra-like syndrome in dogs described by Chittenden and Underhill. Their clinical, epizootological, and gross post-mortem notes are of real interest and value because, as they observe, the condition is probably the analogue of human pellagra.

We have been unable to find evidence in the literature or otherwise that black tongue of man is of other than entirely local pathology,

practically symptomless, and with meager signs, at best. Because it is quite a rare occurrence, we considered that possibly some of the naval medical and dental officers, not having had the condition expressly presented to them by actual clinical cases or in the NAVAL MEDICAL BULLETIN, might not be conversant with it or else not especially on the lookout for it. Interviewing medical and dental officers led us to believe that this consideration as to the status of black tongue in our diagnostic armamentarium was accurate and, as our own cases were discovered quite by accident, we feel that the presentation of them might be of some timely value or at least of no little interest.

DEFINITION AND SYNONYMS

The nonsurgical condition of the tongue of man, usually referred to as black tongue, while entirely a local disease, without striking pathology or alarming clinical manifestations, is but rarely encountered. It never fails to arouse intense interest in those privileged to observe it, especially when they learn that its etiology is not as yet established.

Black tongue, according to the older, parasitic theory of its etiology, is a benign, fungous, parasitic affection localized on the dorsum of the human tongue as confluent or discrete patches of soft, densely massed, silklike filaments showing varying intensities of black, brown, yellow, and green color combinations and evincing a chronic course, devoid of alarming or systemic symptoms. The "densely massed, silklike filaments" are the filamentary processes of hypertrophied filiform papillæ, as shown by pathological microscopy, and the many shades of the above color combinations are resultant from foods or attending food-decomposition products, tobacco, and the oxidizing or reducing actions of chemicals, drugs, mouth washes, etc. The most common colors of the lingual patches, which are often described as "furlike," are varying shades of brown-black and yellow-black.

The designation black tongue, like the name of the organism considered to be the etiologic factor, has been given a host of synonyms by the various workers, such as *nigrities linguæ*, *melanotrichia linguæ*, "black-fur" tongue, "black-hairy" tongue, *keratomycosis linguæ*, lingual papillary keratosis, etc. German, Schwarze Haarzunge; French, Glossophytie.

HISTORY AND BIBLIOGRAPHY

Medical literature upon black tongue—or conditions now thought to have been such by reason of the authors' descriptions—has been of cursory and sketchy nature up to the last century. The lack of

an established or common terminology in the designation of this and other tongue conditions, as well as in their descriptions, made confusion inevitable. The difficulties of expressing an exquisite word picture in one language by the pseudoequivalents in another added vague uncertainties to the translations from the originals. Thus, in 1557, Amatus Lusitanus stated that he found hairs upon the tongue of a man which, when pulled out would renew themselves. It is now thought that he dealt with the condition now termed black tongue, and to him is ascribed the first work on the subject, though he did no more than mention it. The nineteenth century is replete with case presentations and reasonable hypotheses as to etiology, but, as might be anticipated, the literature is confined to the descriptive, for, until the close of the century, all was mere speculation in the field of etiology and treatment. Even as late as January, 1923, Dr. Herman Prinz read before the Philadelphia Academy of Stomatology as follows: "The disturbance, generically referred to as black tongue, has aroused my special interest on account of its undetermined etiology"—this in the face of his own work on the etiology and the voluminous evidence presented since 1890 by the texts and work of such men as Stitt, Cziaglinski, Hewelke, McFarland, Heidingsfeld, Oppenheim, Butlin, MacLeod, Castellani and Chalmers, etc.

Prinz, from the work at the pharmacologic laboratory, Thomas W. Evans Museum and Dental Institute, University of Pennsylvania, formulated his most comprehensive monograph on black tongue which culminated the history of a new epoch, venturing with gratifying results into the old difficulties of etiology and treatment. His conclusions, along with those of other recent workers, are given in the appropriate chapters elsewhere in this article.

Other works of our own century must be mentioned in the historical outline of this disease; they are those of Coffin, Spencer and Butlin, Schnabel in 1904, Urbantschitsch and Blegvad in 1908, Zilz in 1911, and Mikulicz in 1922. The Diseases of the Tongue, by Butlin and Spencer, appeared in 1900, as did also the work by A. Coffin in the Journ. des Mal. Cut. et Syph., Feb. 1900, p. 65.

The descriptive works in the past century on this disease, as given by Prinz, are those of Rayer in 1835, Salter in 1852, Eulenberg in 1853, Gubler and Raynaud in 1869, Dessois in 1878, Hutchinson in 1882, Vigual in 1886, Schech in 1887, Brosin in 1888, Leviseur and Dinkler in 1889, Mourek and Sendziak in 1894, Wallerand in 1890, and Vollmer in 1898. The work of E. Vollmer is found in the German Arch. f. Derm. u. Syph., Oct. 1898. The more recent descriptions, however, are not inferior to these. A recent discussion by Dr. Henry K. Gaskiel impresses us as particularly graphic: "One word

about the hairy black tongue, which is not always black and certainly is not hair. One patient said that he felt all the time that he had been out the night before and had had too many drinks and too much tobacco and that his mouth was full of tongue. He would cut the 'hair' off and learned to cut it without any bleeding; and at the expiration of three or four months he would have a 'mouthful of morning after' and would proceed with the scissors again. I can not help but feel that it takes rather drastic measures to cure this disease, which is an outgrowth of something on the papillæ."

Theories of Etiology

Most authorities on black tongue held that the causative organism of the growth on the tongue was a yeastlike cell with cell properties closely simulating those of Saccharomyces, a genus of fungus protophyte. It has been given various names by different writers. This species, *Cryptococcus linguae pilosae* (Stitt), is considered to be of infrequent occurrence in pathology. It is of the genus *Cryptococcus*, family *Saccharomycetidae*, suborder *Gymnoasceae*, order *Ascomycetes*.

Cziaglinski, Hewelke, and many others agreed that the etiologic parasite was a yeastlike mold. This school of workers named the organism *Mucor-rhizopodiformis* and characterized it as a dark-colored, yeastlike mold. McFarland claimed to have isolated the fungus in pure culture. This was certainly a remarkable accomplishment, since the fungus was admitted to be extraordinarily difficult to isolate. Dessois designated it "Glossophyton" and said it is exceedingly rare. Guéguen designated the fungus *Nocardia lingualis* (1908) and Brumpt called it *Discomyces lingualis* (1910).

Yeastlike, fungous cells, either oval or spherical, occur alone or in chains, and some genera show formation of a mycelium or network of outbranching filaments, while some also possess "aerial hyphæ." Proliferation is by budding or spore formation, certain genera showing spores in the interior of filaments, by chlamydospores or by ascus formation. The *Cryptococcus* of black tongue was described as an elongated yeast-like cell, reproducing by budding but without ascospore formation (Stitt). One cell was thus the autonomic, viable unit of the *Cryptococcus*, as in the case of the *Saccharomyces cerevisiae* or ordinary yeast fungus. Castellani and Chalmers state that the fungus appears as bacillary bodies less than 0.3 microns in diameter and that in culture it shows mycelium formation of very thin filaments. This fungus, described by these two authors, is stated by them to be associated with the *Cryptococcus linguae pilosae* of other writers.

The disease is not contagious and the organism is considered but mildly infectious, so that, in order for the disease to be contracted, conditions have to be peculiarly favorable and certain predisposing factors present. To illustrate, both of our cases showed a premonitory stomatitis due, no doubt, to the mercury exhibited in the treatment of conditions antedating the black tongue. We feel certain that a catarrhal stomatitis is a precursor of and an attending predisposing factor for black tongue and that exciting causes of stomatitis must be considered in the etiology and treatment; i. e., neglect of oral hygiene, acid fermentation of food remnants, improper diet, and the use of certain drugs, as mercury, bismuth, etc. This view is also a reasonable deduction from the work of Osler. According to Osler, a catarrhal stomatitis, irrespective of cause, predisposes to *Oidium albicans* (Robin), an organism of the same nature and family as that considered the cause of black tongue. Prinz remarks, in this respect: "As is well known, mercurial administration readily causes stomatitis and glossitis, and this, in turn, may predispose the thus irritated tongue to this disease." A similar case of stomatitis with a condition simulating black tongue has been observed by Dr. Robert H. Ivy, who comments as follows: "Under agents that produce pigmentation of the tongue might be mentioned bismuth subnitrate. I once saw a patient with bismuth poisoning, caused by the injection of bismuth subnitrate paste into a suppurating pleural cavity, evidenced in the mouth by salivation, fetor of breath, gingivitis, loosening of the teeth, and a generalized bluish-black discoloration of the mucous membrane, including that of the tongue."

It is evident that the bismuth case just cited was not true black tongue, however, but was the local effect upon the tongue and buccal membranes of the bismuth toxicosis. This case brings up the subject of the possible discolorations of the tongue and their bearing upon true black tongue. The possibilities are many and diverse—volitional deception as seen in the hysterical or mentally aberrant patient; accidental local action of chemicals, foods, foreign materials, etc.; effect of exogenic toxicosis as shown by the case just cited. Wallerand called attention to a black tongue due to the collection of coal dust, the analogue of pulmonary anthracosis; he called this condition *anthracosis lingualis*. A black, iron-oxide tongue stain is not uncommonly due to the use of iron-reducing or oxidizing solutions as mouth washes in the treatment of various mouth lesions attended by blood oozing from an inflamed mucous membrane. This is seen in some mercurial stomatitis cases as a not unfavorable precursor of the black tongue pigmentation.

Oppenheim, however, has recently demonstrated three cases reported to be typical black tongue as the result of his own artificial

experimentation. The tongues of "Group 1" of the subjects were swabbed three times a day with tincture of nutgalls and the tongues of "Group 2" with hydrogen peroxide as often. Within a week 3 patients out of 17 employed in the experiment developed typical black tongue (according to Prinz, quoting Oppenheim). In like manner Loiselet, Gaston, and Schourp report accidental cases caused by the use of hydrogen peroxide as a mouth wash, while Leviseur reports a case resulting from the cauterization of tertiary mucous patches with chromic acid and silver nitrate, using astringent mouth washes at the same time. In this latter case, however, it is evident that the presence of lues and the attending mercury treatment vitiates the etiological significance of the cases as evidence in favor of either the "chemical," "luetic," or "parasitic" theory of black tongue.

Many observers favored the "syphilis theory" of etiology, but most all have discarded it, for, as pointed out above, the mercury stomatitis attending mercury treatment is the predisposing factor rather than the syphilis as such. It is known, too, that black tongue does occur more often in those of ill health and should be routinely searched for in those with debilitating systemic disease, infectious or metabolic. In this sense, of course, syphilis is also favorable for the development of the intercurrent tongue disease.

Bertrand and other writers have considered black tongue as due to deposit of melanin-like pigments within the surface epithelial cells. This association resulted from the observation that certain species of animals and birds had a normal pigmentation (bluish or bluish-black) of the buccal membrane or tongue. The "blue gum" seen in the negro was also pointed to as a modified form of normal melanosis. There is now thought to be no relation between the pigmentation of these conditions and that of true black tongue—just as this latter condition is entirely distinct and separate from "black tongue" of dogs which shows some similarity to human pellagra, the membranous discoloration of the mouth being a pigment disturbance upon a trophoneurotic basis.

Urbantschitsch, Blegvad, and Zilz have supported the theory that the etiology lies in some congenital defect, predisposing the tongue to this condition. Blegvad assumed that the filiform papillæ are unusually large at birth and later become irritated by disease or foreign agents and hypertrophy results; secondary staining of the papillæ by foods, chemicals, etc., next takes place. Zilz now emphasizes the primary cause of black tongue to be a trophoneurotic disturbance and cites two of his own cases to confirm his views, while Urbantschitsch concludes that the etiology lies in two factors, i. e., chronic irritation and chemical pigmentation. The latter also pre-

sents two cases in which the stripped off papillæ showed, upon analysis, the presence of iron, while both cases, like the writers' two cases, were associated with stomatitis.

Heidingsfeld, in 1910, announced the condition to be "hyperkeratosis" of the filiform papillæ with discoloration due to an intensification of their normal color as the result of age, drying out, and condensation of the superficial epithelial cells of the hypertrophied papillæ. This view was supported by Schech and Brosin.

Prinz expresses his own views on the subject as follows: "Black-tongue owes its origin to some constitutional state in the form of a trophoneurotic disturbance which electively predisposes the surface of the tongue to an irritation by specific substances. As a consequence, primarily, the filiform papillæ hypertrophy and become densely matted and secondary deposits of pigments derived from external sources takes place. The black color is primarily represented by iron compounds obtained from the decomposition of the hemoglobin of blood deposited upon the dead keratosed epithelium of the matted papillæ."

In the light of these investigations it is evident that the disturbance is primarily a hyperkeratosis of the filiform papillæ with the deposit of pigments upon and betwe n the enlarged papillæ. The papillary hyperkeratosis is said to be due to the action of irritating agents whether they be drugs, chemicals, bacteria, or fungi; the result, in all events, is chronic irritation and, if local conditions are adjusted to a favorable nicety upon the basis of the peculiar systemic status already explained, and with the factors of hygiene, habits, etc., not adverse—the way is prepared for black tongue. Since black tongue is quite uncommon it follows that this particular combination of favorable circumstances is not commonly effected. Certain it is, however, that no longer is a purely "parasitic" or a purely "chronic-irritative" theory adequate. Evidence to date points to two particular theories for the accurate explanation of the etiology; in other words, the research data upon etiology of the condition indicates two classes of cases, namely, those caused by the "chronic-irritative-hyperkeratosis" etiologic complex and those caused by the fungous or "parasitic-hyperkeratosis" complex. Thus, until more conclusive and more extensive research has finally discredited this second or parasitic theory, black tongue must remain, from the standpoint of etiology, classified as the two types—(1) parasitic and (2) nonparasitic. It is true that the latest work tends to the repudiation of the parasitic etiology, but McFarland's claim to have isolated the fungus in pure culture has not been conclusively discredited, while the *Cryptococcus linguae pilosae* or *Mucor rhizopodiformis* of Hewelke and Cziaglinski still haunts the

texts and laboratories as an embarrassing specter awaiting final disposition. Whereas the nonparasitic or "chronic-irritative-hyperkeratosis" etiology has gained common acceptance in the light of recent work, and, largely too, because of its apparent logical simplicity, Prinz suggests that it is perhaps not the manifest simplicity it seems to be. In other words, it remains to accept or reject the idea advanced by Prinz. His proposition as to the fundamental nonparasitic etiology is here quoted again. "Its origin is some constitutional state in the form of a trophoneurotic disturbance which electively predisposes the surface of the tongue to an irritation by specific substances."

Improper hygiene, defective sanitation, poor food, overwork without proper recreation, and the various excesses of pernicious living have also been thought to predispose to black tongue, especially in persons of recent arrival in the Tropics. These factors are operative in the etiology in no specific sense, of course, and only in the manner that they impair general resistance to other morbid processes. One of our cases developed three months after the patient's arrival and upon his first visit to the Tropics. The other case was that of a man who had seen much tropical duty (see history of Case 2) but experienced disease seven years after returning to the mid-west United States. Living conditions peculiar to the Tropics have been suspected of influences favorable to the development of black tongue. The influence of the Tropics is, no doubt, more apparent than real, for it has been observed that other known factors of etiology are always operative. The most common diseases with which black tongue occurs intercurrently are syphilis, chonic intestinal diseases, diseases treated with certain drugs, as mercury, bismuth, etc., and resulting in or attended by catarrhal stomatitis or chronic irritation of the filiform papillæ.

It will be noticed in our first case history that the patient was in the habit of almost continuously eating "life-savers," a candy breath deodorant, because of cigarette smoking. Thus, protracted bathing of the tongue in a sugar medium was effected by the hard candy being allowed to dissolve upon the tongue. It occurred to us that this would enhance the cultural conditions favorable to the etiologic fungus if it were present. The warmth, moisture, sugar, and shelter from the sun's rays impressed us as a favorable combination of circumstances for the growth of oral fungi if accidentally present. Of course the other complicating factors operative, as already mentioned, were kept in mind—the mercury treatment and attending stomatitis, etc. Both of our cases showed these two factors; nor have we heard of a case in which the stomatitis was not present and which therefore might serve as a "control case" in the

clinical study of cultural conditions in the mouth. The most natural result of the prevalence of stomatitis or irritative processes in black tongue has been, as already suggested by us, to accept also the non-parasitic or "chronic-irritative-hyperkeratosis" etiology of the more recent workers but to withhold final decision as to the "tropho-neurotic" and "selective irritation" as propounded by Prinz. It appeared to us that the habit of dissolving the peppermint "life-savers" upon the tongue over the period of two years was also operative as an aid in the production of a stomatitis and was a factor in the chonic irritation present. Nor is the habit of excessive smoking without effect in the chronic irritation such as observed in both cases here presented.

Blegvad found the incidence to be twice as great in the male as in the female. The age limits in his cases were 1 to 75, with greater incidence between 20 and 50.

In closing this chapter it might be of interest to remark that, like most uncommon conditions, black tongue has seemingly a faculty for appearing when it is least expected and for the display of capricious attachment for the patient who most desires to avert it. Its incidence is especially flagrant since it will, as in the first of our cases, be found, at times, in persons with little other evidence of morbidity. In our cases, however, some of the etiologic factors enumerated above were found to be present by means of a more exhaustive study.

Laboratory Procedures and Clinical Pathology

We have shown the history of black tongue to reveal the claims of certain investigators to having isolated an etiologic fungus in pure culture and the establishment of the "parasitic" etiologic concept. Nor has this concept as to etiology been conclusively refuted, in spite of the innovations of recent workers and the advent of the "chronic-irritative-hyperkeratosis" etiology referred to in the previous chapter. Suffice it to say that there has been no recent reported success in the culture and isolation of the black tongue organism. Our attempts in both our cases were without success, as those of other writers seem to have been, or else they purposely avoid mention of the elusive fungus, dismissing the issue because of the recognized difficulties in the artificial culture of this type of fungus. After study of a case of black tongue at the United States Naval Medical School recently, Doctor Houghton reports the *Aspergillus niger* as the only fungus obtained, and this he believed to be one of the frequent contaminations and without significance. Sabouraud's medium as well as the routine tubes was used.

The attempt was made to culture any etiologic fungus present in the case presented in case history No. 2, under proper laboratory conditions at a naval hospital, by one of the writers and his associates. There resulted only the confusing mixture of usual oral organisms.

The case presented in case history No. 1 was encountered at sea, and culture attempted with the limited provisions aboard ship. Sabouraud's medium, as given by Stitt, was not available, nor was it possible to have but the approximate adjustment of medium reaction. Stitt advises adjustment to about +2 reaction. The collected specimens were placed in 60 per cent alcohol for one hour to inhibit bacteria. Inoculations were made in glycerin, bread paste, potato medium, agar, gelatin, and liquid petrolatum. The moist chamber of Plauth, as given by Stitt, was also resorted to but with as little success as in the above procedure.

The original specimens were examined by hanging drop, in their dry natural state, mounted in 10 per cent caustic soda solution, in liquid petrolatum and by Tribondeau's method. Specimens obtained by scraping the tongue were stained by Wright's and Gram's methods after the fat and detritus removal advised by Stitt. Hanging block cultures were made. At the end of 24 hours macroscopic survey was made of the preparations. At the end of 48, 72, 96, and 168 hours microscopic examinations of the cultures were made by the procedures just related in the study of the originals. We have since learned that Sabouraud retains these cultures of fungi over a period of weeks (six or more), and that they are examined at frequent intervals, as some of them are slow growers and others capricious in their viability upon various media. There are never liquefaction nor fermentation processes, however, so that if these reactions occur there are present only the usual saprophytes. No fungus nor characteristic organism was obtained other than the usual oral flora.

With the original specimen, examinations had all been negative. Care had been taken in their collection. Three methods were used, following careful cleansing of the teeth, throat, and mouth with normal saline wash. Gauze dipped in normal saline solution was used to wash the tongue mildly. The growth upon the tongue was then obtained by plucking it away with sterile forceps, leaving surfaces which did not bleed; some was obtained by deep scraping with a sterile scapel, which was also used in a third method of removing a portion of papillary superficial epithelium in the hope of obtaining any fungus too deep in the tissues to be caught by the other two methods. The hairlike material pulled away by the forceps consisted of the keratosed papillary processes and epithelial cells, dead and living. Small masses of these matted hairlike processes ap-

peared of vacuum-cup design at their proximal ends upon being pulled from the tongue.

The pathological report upon a biopsy of black tongue shows the hypertrophied filiform papillæ covered by the usual diverse organisms of the human mouth, while there are varying degrees of keratosis of nonnucleated, stratified, and closely superimposed epithelial cells (Prinz). We have not been able to find a report of the cryptococcus or parasitic bodies having been found in the tissues of biopsy.

Houghton reported that his black tongue patient also showed a pruritis ani and that he secured a fungus upon culturing the lesions. At the time of our interview he had not made final study of the fungus.

We were able to confirm the reports of experimental black tongue in the literature, as Prinz has also done. We used the method devised by Oppenheim and successfully demonstrated by him, i. e., the application of hydrogen peroxide or tincture of nutgalls to the tongue of a normal person three times a day. Selecting 10 subjects free of stomatitis and apparently normal in other respects, the applications were begun three times a day, while drugs, smoking, chemicals, diet, etc., were controlled as much as possible to avoid other oral irritations or discolorations. The five hydrogen peroxide subjects continued the experiment without a show of anything resembling black tongue. Two of the nutgall subjects, however, at the end of the third week showed significant changes. One appeared to have developed a typical black tongue; the picture was complete, i. e., hyperkeratosis of filiform papillæ in "hair-like" formation, dirty yellow-brown pigmentation, prominence of circumvallate papillæ, slight stomatitis, etc. The changes in the second subject were of the same character but not nearly so well marked and noted only upon careful examination.

Prinz reports that of six students of the Evans Institute he was able to produce in one, a Hindu, an artificial black tongue which was pronounced to be the typical condition by the various members of the faculty of the institute who examined the subject. The tongues were swabbed twice a day with tincture of nutgalls (N. F.). Within about a week only one subject showed slight enlargement of the filiform papillæ and a slight brownish stain. The other students showed a very slight or no variation from a normal tongue. By the end of the second week there was a deep brown stain and marked enlargement of the papillæ seen on the tongue of the Hindu subject. As there was a negligible degree of stomatitis, the gums were artificially bled and later the tongue surface swabbed with iron sulphate to facilitate the deposit of iron pigments upon the papillæ.

A pronounced blackish-brown discoloration was obtained which remained for a few days in unaltered intensity.

Symptomatology

The symptoms of black tongue, like those of Rötheln, are conspicuous only by their mildness and unimportance. The first month of the course is attended usually by a slight fetor of the breath, but the patient is usually unaware of it, unless, observing a developing growth upon his tongue, he becomes more critical and is therefore able to designate it as a chief complaint when he consults a physician, which is usually a month or more after the actual onset of the condition. By this time the patient has noticed a more or less frequent "tickling" of the soft palate and upon examining himself is very apt to make his own diagnosis of "growth upon the tongue." The fine, hair-like, hyperkeratotic processes of the papillæ appear as the "hair of a wet dog" or "the leaning grain of a wheat field torn by the wind and rain." If the keratosed processes are long enough, there will be irritation of the pharynx, sensation of swollen tongue or "crowded mouth," and unusual salivary activity. Both of our cases showed this hyperactivity of the salivary and buccal mucous glands. Well-marked, diffused stomatitis was also observed in both cases. This is seen in most every case of black tongue, but, as has been shown, is now considered an incident in the etiologic complex and not of symptomatological importance. In spite of the salivation the tongue feels dry.

Upon stroking the "hairs" toward the tongue tip they are matted together and present a smooth glistening surface, but, if stroked in the opposite direction, they at once "bristle up," much as the fur of a cat's back.

Another objective symptom of all cases is the hypertrophy of the filiform papillæ. The circumvallate papillæ also appear enlarged but without the "hair formation" effect.

There are numerous color variations as to quality and intensity seen in true black tongue. These must be differentiated from the discolorations seen in other diseases, such as xanthelasma and melanoplakia, or in a toxicosis, such as argyria, or attending certain habits, as betel-nut chewing in the Philippines and Far East and smoking, or accompanying certain diet, drugs, chemicals, etc., or incident to occupation, accidents, and the willful pigmentation by those of defective psyche.

Diagnosis

In the established and well-marked case, such as usually seen, the diagnosis is not involved, for the tongue is black. There is limitation of the black pigmented "growth" to the central and anterior

central areas of the tongue, the peripheral and the anterior fifth of tongue area being usually clear. There is apt to be a whitish fur-like coating of these latter areas, however, but with the normal pink, unaffected tongue tip.

Confusing variations, however, are not so uncommon, and especially as to color of the "growth" on the tongue. Colors, as the following, are encountered in different cases and the varying stages of the same case: Light gray, dull gray, dark dirty gray, sepia, saffron, varying shades of yellow, brown, or admixtures of one or all of these with black, which latter will also be often defined at a few small, isolated, central areas only. As the process advances these colors most often are progressively replaced by the black, but, in some cases, they persist throughout the entire course. These colored "patches" are always anterior to the circumvallate papillæ.

The light gray is seen in the early stage of almost every case and commonly becomes a dirty or dark gray in a few weeks. Then, in one to four weeks, the above colors or their many shades and combinations will develop.

A white, furlike coating of the tongue, not unlike thrush in gross appearance, was seen in the very onset of one of our cases. The tongue appeared thickly coated and could not be cleared by systematic catharsis, rigid oral hygiene, or scraping. Nor was there any change upon adoption of a low meat diet and measures designed to improve elimination and decrease autointoxication, as daily systematic exercise, high water intake, decreased nitrogen intake, with relative increase in fruit and vegetables. Night life was avoided and alcohol was not indulged in, but the smoking of cigarettes was not discontinued. Moderate constipation persisted and, as the coated tongue with somewhat fetid odor of breath suggested autointoxication, systematic catharsis was pursued. The thick white coating of the tongue persisted for three months, during which time the patient persisted in his habit, already mentioned, of dissolving deodorant candies upon the tongue many times a day. Scraping of the tongue was tried only three times, as it was in no way encouraging and we had before us the experience of our other case which actually became worse under persistent trials at removal by scraping. Scraping, as we later learned, made the condition return in more pronounced form.

After three months of the above status, which might have been well named "white tongue," there appeared the yellow coloration in the mid portion of the tongue which spread peripherally and became dark yellow, dirty yellow, yellowish-brown, and black in rapid succession. The color changes had occupied a month, and now peripheral extension was never resumed, while the areas noted above were indeed black—and very decidedly so—as if the patient was

given to eating the small, black, gum-candy eggs so common at Easter time. Attention was therefore given to the possibility of artificial or dietary discoloration, but there was no evidence in that direction.

There was a deep fissure directed lengthwise in the midline of the tongue and through the center of the "growth." This is well seen in the photograph; in actual appearance it resembled the skin line between the parted masses of hair on a wet dog. In fact the growth has been variously described by various writers as "the fur of a silk hat," by Blegvad, or as "a field of grain laid low by hailstorm," by Gubler.

Hypertrophy of the filiform papillæ is also a diagnostic feature of black tongue and must be closely studied, for it is an invariable concomitant. It was well marked in both of our cases but can not be made out so well on the photographs.

Characteristic signs localized on the tongue and not resembling any other condition to any marked degree should at once suggest black tongue. The insidious onset and mildness or even absence of subjective symptoms will point to the same condition. There is no record of untoward symptoms or impairment of health as a sequel of human black tongue.

The case should be referred to the laboratory for corroboration by means of biopsy and bacteriological study of the fungi or other organisms present.

Differential Diagnosis

The *Oidium albicans* (Robin) or thrush fungus is, of course, more common in children but does occur in adults in the final stages of febrile diseases, tuberculosis, diabetes, and the cachectic states (Osler). Thrush (Soor; Muguet) begins as slightly raised, pearly-white spots which enlarge and coalesce, forming a membrane which can be readily scraped off. It also may spread to the cheeks, lips, hard palate, and even tonsils and pharynx. The entire buccal mucosa may be affected, and it has been found on the vocal cords, in the oesophagus, stomach, and cæcum. The mouth is dry and there is no ulcer formation.

The black tongue fungus is much more uncommon than the thrush fungus and is usually in adults. Black tongue begins as a white or grayish coating of tongue as contrasted to the slightly raised, pearly-white, small spots which coalesce in thrush. Thrush shows a tendency to spread to tissues other than the tongue which is not seen in black tongue. Thrush infection also presents a dry mouth; black tongue shows excess of salivary function.

Aphthous stomatitis also shows the contrast to thrush of marked salivation, and there is vesicle followed by ulcer formation not seen in either thrush or black tongue.

Diagnostic confusion with the stomatitis of sprue or psilosis is of negligible probability, for here there are superficial buccal ulcerations and distressing systemic disturbances—neither seen in black tongue. As Manson so graphically remarks, "Sprue is characterized by a peculiar, inflamed, superficially ulcerated, exceedingly sensitive condition of the mucous membrane of the tongue and mouth; great wasting and anemia, pale, copious, and often loose, frequent and frothy, fermenting stools; very generally by more or less diarrhea, and also by a marked tendency to relapse."

Acute or simple stomatitis could be confused with black tongue only in the earliest stages of the latter. With incidence equally frequent at all ages, it is encountered as the commonest mouth affection next to caries and sepsis of the gingivæ, while black tongue is quite rare; it is found to be upon a basis of local irritation—tobacco, hot or highly seasoned food—or as a concomitant of indigestion, specific febrile affections, and the dentition or gastrointestinal disturbances of ill-nourished, unhealthy children (Osler). This condition may affect the tongue much as does early black tongue, for an increased secretion follows closely upon an initial dryness of the mouth, redness of the membranes, and "furring" of a tongue indented by the teeth. Although the black tongue cases show a catarrhal stomatitis, the reddening of the membranes was not marked nor was it progressive as in acute stomatitis. Limitation of actual "growth" to tongue, subsequent color changes, and biopsic microscopy would, of course, establish a diagnosis of black tongue.

Gangrenous stomatitis is rare, found only in children of wretched environment or convalescing from acute fevers, especially measles, scarlet and typhoid fevers, and begins in the membrane of the gums or cheeks. While it may attack the tongue, it rarely does so, except in the last stage, when the mandible is also apt to be involved and the diagnosis has long been evident. The progressive gangrene, sloughing and destruction of tissues, with signs of great illness, make this condition far removed from the province of black tongue with its dearth of symptoms and its benignity.

In like manner ulcerative stomatitis is so dissimilar from black tongue stomatitis that it would scarcely present a problem of differential diagnosis except in the very earliest stage. It occurs particularly in children after the first dentition and is often institutional, epidemic, occurring under neglect of oral hygiene or defects of sanitation. There are multiple ulcers with bases of grayish-white, adherent membrane, while the gums, where the process begins, are red and swollen. There may even be necrosis of the alveolar

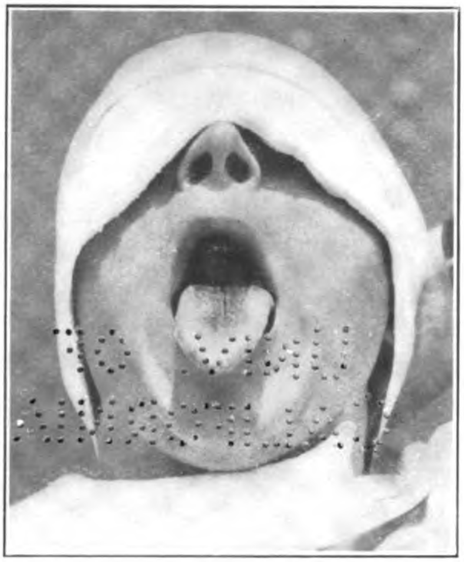

FIG. 1.—CASE 1, BEFORE TREATMENT

FIG. 2.—CASE 1, AFTER TREATMENT

process with loosened teeth, and the tongue very rarely shows ulceration. There is also painful mastication, which completes a picture very different from stomatitis of black tongue. The developing salivation and foul breath, however, are not unlike the latter.

Eczema of the tongue and *icthyosis lingualis* (Plumbe) are so distinctive in any stage of their courses that they are not even problematic in the differential diagnosis of black tongue.

Prognosis

The prognosis is very good. The disease may persist for many months but only rarely disappears spontaneously. Most cases quickly clear up under proper treatment; even the most intractable ones can be cleared up by persistent treatment. Recurrences are common, especially after treatment by scraping the tongue to remove the "growth." Our case presented in history No. 2 was treated at first by this method, which seems to us to favor early return of the "hair" and in a more pronounced form.

Treatment

MacLeod has advised a 1 per cent solution of salicylic acid applied daily to the patches upon the tongue; alkaline mouth washes containing borax or potassium chlorate are also used in this treatment.

We followed the treatment as advised by Prinz in one of our cases. He advises a 10 per cent solution of salicylic acid in alcohol and glycerine, 3 per cent hydrogen peroxide, and normal saline solution.

Case 1.—Mouth sprayed prior to treatment with normal saline solution. Tongue wiped with dry sterile gauze, then painted with cotton applicator saturated in a 10 per cent solution of salicylic acid in alcohol and glycerine, equal parts; this was followed in a few seconds with a 3 per cent solution of hydrogen peroxide and then by a normal saline solution (Prinz). This was repeated daily for nine days. After the third day some of the "growth" was removed by the mere wiping of the tongue with gauze. The "growth" seemed to have the appearance of dead wood and could be easily removed. At the end of the tenth day the growth completely disappeared and has not recurred.

Case 2.—Mouth sprayed with normal saline solution prior to treatment. Tongue wiped dry with gauze; quartz applicator applied to tongue, and ultra-violet radiations from water-cooled, ultra-violet-ray machine played over growith, pressure being used on applicator to intensify the therapeutic action of the ray by virtue of deeper penetration. First treatment consisted of a five-minute exposure

to the tongue; on each subsequent treatment the time was increased one-half minute for 10 treatments until the last treatment consisted of one 10-minute exposure. Care was exercised to protect the adjacent tissues of the lips, cheeks, gums, palate, and pharynx to prevent burning. No blister nor soreness of the tongue was noticed at any time by the patient. Home treatment consisted of a normal saline mouth wash and brushing of the teeth three times a day. Tongue was not scraped during nor after treatment and growth seemed to "fall off." After patient reported for the eleventh treatment no growth was observed, and it had not recurred three months later.

Summary of Treatment

Of the two treatments there is little difference as to value, since approximately the same results were gained in about the same number of treatments in both, and each treatment appears to be highly efficacious. Possibly the medicinal treatment will cause less strain on the patient, and in cases where patients gag easily it is more efficient, as some difficulty will be experienced in keeping the quartz applicator on the tongue during the treatment, due to hypersensitiveness of the tongue to the applicator; also less drooling accompanies the medicinal treatment and less time is consumed per treatment. The ultra-violet-ray machine is not available to all practitioners; therefore the medicinal treatment is the most convenient. The latter treatment is also efficacious as any which we have been able to find in the literature.

We regret that we have but one case to present under each of the above treatments. There is ample corroboration of the results in the salicylic-acid treatment, so that it is now established and accepted. This is not true of the ultra-violet-ray treatment; more work must be done before it can be accepted. We present it here with reservations and the hope that other workers will aid the appraisal of its true value in the treatment of black tongue. Because black tongue is quite rare, we are especially solicitous to be extended the courtesy of case reports or any data as to etiology and ultraviolet therapy.

CASE HISTORY I

Chief complaints:

Slight "tickling" of roof of mouth. Sensation of swollen tongue or "crowded mouth." Has "growth" upon tongue and bad breath. Increase in saliva formation in mouth. Moderate constipation.

Present illness:

A light gray coating of the tongue persisted for months, but was not of unusual appearance, being similar to the tongue condition due to sluggish intestinal action. In fact the patient at this time was moderately constipated

and the tongue was accepted as a logical result. A chronic acne of the face, also present at this time, was regarded as due to autointoxication. Attempt was now made to clear up these conditions by catharsis, mercury, and salines, but without improvement. Instead, the tongue gradually became more heavily coated since it was first noticed in late January, 1925, so that in early March there was a thick "fur" on the tongue, which was now dark, dirty gray, with a yellowish tinge. The tongue remained in this condition during March and April, 1925. It could not be cleared by rigid catharsis, careful oral hygiene, diet regulation, nor scraping. Moderate constipation persisted throughout.

In the first week of May, 1925, the tongue coating was noticed to be of a dirty, yellow-brown color, while a fine, short "hairlike growth" was noticed in one central patch about 2 centimeters in diameter. This patch enlarged very slowly, the "hair" of the "growth" advanced in length from one-sixteenth inch to one-eighth inch and then to a quarter inch in one isolated area, and the color became darker brown and finally black. By June 1, 1925, a well-defined black tongue as described in the above chapter was established.

Past history:

Youth—Measles at age of 3 years. Pneumonia at the age of 6 years. Mumps at the age of 9 years. No complications nor sequelæ of any of these.

Maturity—Two attacks of acute follicular tonsillitis. No complications nor sequelæ. Moderate constipation at irregular intervals. Slight acne vulgaris (chronic) of face for past two years; is not marked nor is it present on any other part of body. Has had a chronic low-grade bilateral palpebral conjunctivitis for past six months. Venereal history negative.

Family history:

No history of family disease or tendencies such as cancer, tuberculosis, nervous or mental diseases.

Habits:

Moderate, except that he smoked about a pack of cigarettes a day for past two years; also during same period of time patient has almost daily used peppermint "life-savers" as a breath deodorant, allowing them always to dissolve upon his tongue. No drugs except mercury and saline cathartics as an intermittent constipation seemed to indicate. Yellow oxide of mercury ointment was used frequently during past six months for the chronic conjunctivitis noted in history. Appetite good. General body hygiene good.

Physical examination.—Male, 29 years old; height, 70 inches; weight, 170 pounds; complexion, ruddy; stature and nutrition, normal; blood pressure, 118 and 74; vital forces, stable.

Head.—Chronic, low-grade, palpebral conjunctivitis of both eyes; it is of mild intensity and symptomless. The mouth shows teeth faultless, but a diffuse catarrhal stomatitis and the typical picture of black tongue as we have described it (fig. 1). Chronic hypertrophied tonsils also present.

Tongue shows area of hypertrophied filiform papillæ (2.5 by 3 centimeters) anterior to circumvallate papillæ. This area is covered with fine, silklike "hair" varying in length from one-sixteenth to one-fourth inch. The center of the area appears black, while the outer one-fourth inch border appears dark, dirty brown.

Neck.—Apparently normal.

Thorax.—Contour unusually good; no asymmetry or muscle spasm.

Heart and lungs normal.

Abdomen.—Thick panniculus. No scars, tumefaction, fluid, asymmetry of contour, or tenderness.

Genitalia.—Normal.

Myoneurological examination showed no abnormality.

CASE HISTORY 2

Chief complaint:

Patient had noticed a heavy black coating on tongue for two months prior to consulting a medical officer; gradually this "growth" grew thicker, and patient noticed long "hairs" on tongue which bothered him when taking a drink of water or during normal deglutition. Was annoyed by a slight tickling of the soft palate and a foul breath.

Present illness:

Patient consulted a naval medical officer, who, because of the rareness of the disease, did not recognize the true condition that existed. Patient then believed it to be a birthmark.

"Growth" persisted and patient consulted medical officers at naval hospital, Great Lakes, Ill., who diagnosed his condition as black tongue. Treatment at this time was regular scraping of the tongue. The growth would reappear after an interval of about a week. Scraping was continued for a period of one year, at the end of which time he was referred to the dental officer. A heavy, yellow-brown coating was observed on the dorsum and center of the tongue extending to the lateral borders and within one-fourth inch of the tip. Long, hairlike processes were seen to be present. These would wave when tongue was dry and patient breathed through his mouth. Upon taking a drink of water these hairs would mat down on tongue, giving the appearance of a wheat field following a heavy rainstorm. Patient was suffering from rheumatism and had been receiving sodium salicylate in capsules for this disease and also electrotherapy treatment. He was mildly constipated, and at one time it was thought this heavy coating was directly attributable to this condition.

Past history:

Usual childhood diseases of mumps, measles, and chicken pox. Several attacks of follicular tonsillitis with no apparent complications or sequelæ. Slight constipation regularly. Muddy complexion, with slight chronic acne vulgaris.

Venereal history.—Negative.

Sixteen years' naval service, several years of which were spent in the Tropics.

Habits:

Heavy alcohol and tobacco user. Apparently no drugs other than sodium salicylate and calomel or saline cathartics had been taken during the history of the condition. Appetite good and moderate exercise taken daily. Patient worked nights.

Physical examination.—Male, about 37 years of age; height, 65 inches; weight, 125 pounds. The tonsils were unhealthy, being hypertrophied and cryptic. The gingivæ were considerably inflamed with some recession. Considerable dental work was present but no carious teeth. Moderate diffuse stomatitis present. Tongue shows typical picture of black tongue as described above. Examination revealed nothing else of significance.

DEVELOPMENT OF VENEREAL PROPHYLAXIS IN THE UNITED STATES NAVY

By C. A. Setterstrom, Chief Pharmacist, United States Navy[1]

For the past 25 years venereal prophylaxis has been a subject for discussion in the Navy. The following is a review of efforts to prevent venereal disease in the United States Navy, commencing with the year 1900, and a presentation of certain factors believed by some to have a bearing on the practice of venereal prophylaxis in the Navy.

The statistics for venereal diseases can hardly be considered of much value prior to 1909, when a keen interest was awakened in venereal prophylaxis. More care was apparent in admitting to the sick list all venereal cases. The low admission rate for these diseases preceding 1909 can not, however, be attributed entirely to the assumption that medical officers did not admit all cases. There were, no doubt, many cases of concealed disease, and a proprietary remedy supposedly guaranteed to "kill or cure" was used, especially by syphilitics. The seemingly miraculous "cures" with salvarsan in 1909–10 encouraged many to come for treatment. The older men were under the impression that an admission for venereal disease would compromise their pensionable status. They contended that if admitted for gonorrhea they could never expect a pension if invalided for rheumatism. It is only within the past decade that a man admitted "not in line of duty" has been given the opportunity of offering testimony in rebuttal. In reviewing the admission rates for the years 1900 to 1909 it should be noted that the personnel of the Navy was gradually changing from very young boys and old men to men in the prime of manhood. Prior to 1901 only apprentice boys between 14 and 17 years of age were enlisted for training. In 1901 and the years following landsmen for training and apprentice seamen from 18 to 25 years of age were enlisted and the older sailormen of the wooden ships were fast disappearing.

It would be incorrect to assume that no effort was made to prevent venereal infection in the Navy prior to official cognizance of the subject. Medical officers had encouraged various measures, such as washing with soap and water and antiseptic solutions. The older enlisted men believed strongly in the application of whisky to the genitals as a preventive. In these days, when prostitution flourished unmolested, prostitutes in seaports, as a matter of self-interest, furnished patrons antiseptic solutions, principally bichloride of mercury, potassium permanganate, and cresol preparations. There are probably medical officers and hospital corpsmen in the Navy to-day who will remember that men came to the sick bay prior to going ashore to request "bichloride" tablets.

[1] Division of Planning and Publication, Bureau of Medicine and Surgery.

Compulsory prophylaxis patterned after the Germans was suggested by Surg. E. W. Arnold in the sanitary report of the U. S. S. *New Orleans* for the year 1901. He described their methods as follows: "Two per cent silver nitrate in water is instilled in the fossa navicularis with a pipette and retained there from three-fourths of a minute to a minute. The prophylaxis for chancroid is disinfection with mercuric chloride solution."

In 1903, according to reports filed in the Bureau of Medicine and Surgery, the German Navy used a prophylactic known as "Viro." The outfit consisted of small tubes supposed to contain a protargol preparation and a larger tube containing formaldehyde incorporated with some base. Directions accompanying the outfit directed the application of the material in the larger tube *before* as well as after intercourse. The manufacturer's circular, printed in English, described the preparation in the smaller tubes as follows: "The solution of silver salt has been made stable by having been brought into a form consistent in ordinary temperature and only liquidating with body temperature." About the "antiseptic creme Viro" the circular continues: "When rubbed on the skin, same forms in a more complete manner than substances as ointments, casein, etc., according to the proposal of Professor Doctor Neisser would be able to do—a thin, dry, protecting cover, working by its contents of formaldehyde in an antiseptic way, and which avoids the touch of the infecting stuffs. * * * After cohabitation the application of water is sufficient in order to remove and render harmless the infecting germs deposited on the cream, as Creme Viro acts as a strongly disinfecting soap." It appears then that "Creme Viro" was a soft soap containing formaldehyde.

Impressed by the satisfactory results obtained by the German medical officers on the Asiatic Station, the squadron commander of the Cruiser Squadron, United States Asiatic Fleet, requested the fleet surgeon of the squadron to investigate their method of venereal prophylaxis. Surg. O. Diehl, the fleet surgeon, reported that the Germans were using "Viro" and recommended that the preparation be placed on sale in the ship's canteens. The squadron commander, in forwarding the recommendation, made a strong plea for its adoption and recommended that, if the materials used by the Germans could not be purchased on the Asiatic Station, the Bureau of Medicine and Surgery should be requested to furnish them upon requisition. The commander in chief, United States Asiatic Fleet, referred the correspondence to the surgeon of the fleet, who stated: "The subject in questions meets with my hearty approval * * * The method of prophylaxis (prevention) in this communication is not new, except as the particular plan is concerned * * * 4. The

placing on sale of these preventive tubes in the canteen might provoke harsh criticism against the service by moralists at home. 5. The expression 'clap tubes, 15 cents each,' would thus easily become a by-word in the ship. It might be just as well to consider the subject from this standpoint * * * 7. I would respectfully suggest that at a suitable opportunity a board be appointed to investigate and report upon this matter." The commander in chief thereupon forwarded the papers to the Navy Department with the following comment: "The commander in chief agrees with paragraphs 4 and 5 of the third indorsement, and believes the putting in operation of this method of prevention of venereal diseases would subject the department to criticism as recognizing officially the necessity of immoral practices. A scheme of this sort might be possible in the German Navy, but would be impracticable with us." No action was taken in the matter and the papers were filed in the Bureau of Medicine and Surgery.

Medical Inspector Henry Beyer, United States Navy, fleet surgeon, in a report of inspection on the U. S. S. *Monadnock*, March 6, 1906, states in reference to venereal disease: "The recently introduced method of mechanical protection seems to have been followed by considerable success in staying the further progress of the disease." Surg. J. M. Edgar, United States Navy, was the medical officer of this ship at that time, but, unfortunately, no information is available about the method.

Surg. Raymond Spear, United States Navy, reported in the sanitary report of the U. S. S. *Baltimore* for 1906 that "All liberty parties were inspected and the men encouraged to take antiseptic urethral injections on their return to the ship after exposure. The result was that the men applied early for treatment for venereal infections and, considering the ports visited, the number of venereal cases was small."

In the NAVAL MEDICAL BULLETIN for October, 1907, Asst. Surg. G. L. Wickes, United States Navy, reported that compulsory prophylaxis had been instituted on the U. S. S. *Wilmington* on December 18, 1906, when the commanding officer approved this medical officer's recommendation. Prior to this time optional prophylaxis was afforded the crew. During the first five months of compulsory prophylaxis, no case of primary syphilis developed, although the crew visited Chinese ports where venereal diseases were notoriously prevalent. During five months in Canton, with optional prophylaxis, 30 cases of primary syphilis developed. This comparison of the two methods, tried under the same infective conditions, speaks well for compulsory prophylaxis. So far as we know, Doctor Wickes was the first medical officer in our Navy to publish a paper

on venereal prophylaxis in which protargol solution and calomel ointment, first advocated by Metchnikoff in 1906, were employed. He advocated compulsory prophylaxis for every ship of the Navy. It is of interest to note that preceding the injection of protargol and anointing with calomel ointment the parts were washed with green soap and water, then with a 1–2000 solution of mercury bichloride.

Navy Department files show that on December 17, 1908, the department approved a report on venereal phophylaxis from the Third Squadron, United States Pacific Fleet, and authorized promulgation of full information to all vessels of the fleet. Disciplinary action looking to the enforcement of phophylactic measures was left to the discretion of commanding officers.

Shortly after this authorization compulsory prophylaxis became effective for the Third Squadron. Medical Inspector O. Diehl, United States Navy, in the UNITED STATES NAVAL MEDICAL BULLETIN for July, 1910, states it was in effect in 1909 and that failure to take prophylaxis was punished. The treatment consisted of 1–1000 mercury bichloride wash, followed by intraurethral injection of 2 per cent protargol and application of 40 per cent calomel ointment. Medical Inspector Diehl stated that the success Surg. Jacob Stepp, United States Navy, had with prophylactic treatment (presumably during 1908) led Rear Admiral G. B. Harber, United States Navy, to authorize and encourage its general adoption on the Asiatic Station. Prior to this time individual medical officers had recommended adoption of systematic prophylaxis, but it was not until the interest of the squadron commander was aroused that venereal prophylaxis could be put in general effect on that station.

The success of early efforts toward systematic prophylaxis is noted by Surg. Raymond Spear, United States Navy, in the UNITED STATES NAVAL MEDICAL BULLETIN for April, 1910: "In 1905, while the U. S. S. *Baltimore* was on the Asiatic Station, preventive treatment was given the men after their return from liberty, with the result that although the ship visited the ports of Sidney, Melbourne, and Auckland for a month each, there were practically no venereal cases on board, and the crew was 'clean.' This happy state of affairs was brought about by an intelligent commanding officer who aided the medical officer in all his recommendations. The English ships which were in these ports at the same time as the *Baltimore*, in most cases, had over 25 per cent of their crews infected with some sort of venereal disease, so the nonexistence of venereal diseases on the *Baltimore* was due to the preventive treatment entirely * * *. On the *Baltimore* a copy of the liberty list was sent to the sick bay, all men returning from liberty reported at the sick bay and were

there checked off. * * * If a man reported that he had exposed himself to infection he took the preventive treatment as follows:

"1. Washed the glans penis with a solution of bichloride of mercury 1–2000 by means of a cotton sponge.

"2. Took a urethral injection of 2 per cent protargol and held it from 30 seconds to a minute.

"3. Rubbed 50 per cent calomel ointment (made up with one-fourth lanoline and three-fourths vaseline or lard) well into the glans penis, foreskin, and shank of penis. Abrasions were not cauterized." In discussing the general preventive measures the writer stated: "If the men understood why they should urinate and by so doing they wash the gonococci out of the urethra, and if they understand that it is possible to wash off the causative agents of syphilis and chancroids by means of soap and water and some antiseptic they will be armed with a knowledge that is invaluable and will usually employ these means of lessening the chance of infection of their own volition."

The Secretary of the Navy, on January 9, 1909, issued a "Confidential Circular Letter for the Information of Commanders in Chief, Commanding Officers, and Medical Officers." This marked the extension of systematic prophylaxis to all ships. The letter read in part: "The success attending the application of a prophylactic treatment for venereal diseases among the ships comprising the Third Squadron, United States Pacific Fleet, has suggested the desirability of its extension to other vessels. * * * Commanding officers will cause the enlisted men to be systematically and fully instructed by the medical officer as to the purpose and limitations of the prophylactic treatment for venereal diseases * * *. The commanding officer shall require that sufficient and proper space, as may be most convenient, in the sick quarters or elsewhere, be provided for the administration of prophylactic treatment to such of the enlisted force as may desire it."

Closely following upon the letter referred to above, the Bureau of Medicine and Surgery directed the issue of Confidential Circular of Information No. 1, No. 2, No. 3, and No. 4. Circular No. 1 contained advice about moral and chemical prophylaxis, while the remainder of the series contained advice for those under treatment for gonorrhea, chancroid, and syphilis.

A fleet order issued by the commander in chief of the Atlantic Fleet on May 22, 1910, made venereal phophylaxis compulsory for vessels in this fleet. It may be safely assumed that *compulsory* prophylaxis was, therefore, in effect on all our naval vessels in June or July, 1910. The order required monthly prophylactic reports to the fleet surgeon. Bichloride of mercury wash, followed by 2 per

cent protargol injection and application of 40 per cent calomel ointment, were made standard treatment.

Reports from medical officers following several years' experience with the standard method of prophylaxis indicated the general opinion that the treatment was effective if taken early enough after exposure. Not satisfied with partial results, medical officers advocated packets for issue to those who were about to go on extended liberty. On some ships prophylactic tubes were sold in the canteen. This led the Secretary of the Navy to issue a circular letter on February 27, 1915, interdicting the sale or issue of such packets as encouraging immorality. He stated that the Navy had become so engrossed with purely medical prophylaxis that educational or moral prophylaxis had been overlooked. Forcibly expressing his belief in the ultimate good to be obtained through educational prophylaxis, the Secretary, nevertheless, advocated continuance of venereal prophylaxis on board ships for those who would, in spite of all warnings, expose themselves.

It was believed that legislation whereby personnel absent from duty due to misconduct should forfeit pay during such absence might have some effect in reducing incidence of venereal disease. Navy Department General Order No. 100 of June 15, 1914, cited the applicability to the Marine Corps of the Army act of April 27, 1914. The act of August 29, 1916, extended forfeiture of pay to persons in the Navy absent from duty as the result of disease due to their own misconduct.

During our participation in the World War the combined admission rate for venereal diseases per 1,000 fell from 149.07 in 1916 to 88.72 in 1917 and to 70.18 in 1918. The Bureau of Medicine and Surgery in a circular letter of September 17, 1917, invited the attention of medical officers to the necessity of maintaining "a well-regulated system of prophylaxis or 'early treatment'." The bureau again in a circular letter of December 5, 1917, emphasized the importance of venereal prophylaxis. Paragraph 9 of this letter is quoted as a reminder of the stringent efforts put forth during the war to protect the armed forces:

"9. Full cooperation with the agents of the Commission on Training Activities is desired, and any evidence that may be obtained from men who have become infected, as to the source of infection, should be given to the agents of that commission who have to do with the enforcement of existing laws relative to the disposition of female carriers in the civil community."

Social hygiene matters were later placed under the cognizance of the sixth division, the morale division of the Bureau of Navigation. It should be noted that the strict measures taken to protect

the personnel in the United States during the war made it hazardous for prostitutes and their agents to solicit men in uniform. The sale of liquor to men in uniform was prohibited, and the men were not welcome in the saloons any more than they were in houses of ill repute. It should not be forgotten that the well-organized social activities for the entertainment of the men placed them in contact with good women. During the war leave was controlled and not so much general overnight liberty granted. Prompt prophylaxis was given considerable attention by district medical officers and prophylactic stations were maintained at convenient points.

After the war the admission rate for combined venereal diseases rose again, and on May 12, 1920, the Navy Department issued General Order No. 530. This seems to be the first order which specifically made venereal prophylaxis compulsory for all commands, ashore as well as afloat. The order stated that failure to report exposure would be regarded as disobedience of orders. The issuance of prophylactic packets or outfits was forbidden. Examination to detect suspected concealment of venereal disease was authorized, provided the commanding officer gave his approval.

General Order No. 69, 16 September, 1921, is in effect at the present time. It differs from preceding orders in that it makes prophylaxis optional by providing that the men may voluntarily report exposure and contains no provision for punishment of those who fail to take prophylaxis and subsequently develop infection.

On February 1, 1922, the Bureau of Medicine and Surgery issued Circular Letter No. 158–1922. It pointed out that prophylactic treatment was apparently of no value after three hours and that 55.4 per cent of the infections reported developed in men who were on leave or extended liberty. These conclusions were based on analysis of statistics from ships and stations. The letter authorized the issue of compound calomel ointment in collapsible tubes to all ships and stations and directed medical officers to issue the tubes to such men as might request them. It was particularly emphasized that the tubes should supplement but not supplant routine prophylaxis.

There is hardly a general measure for the control of venereal infection that has not been suggested and tried in the United States Navy. Before the World War naval officials went so far as to exercise some control over infected prostitutes. In one Atlantic port a man who would become infected would be escorted to the woman concerned; and if she was found to be infected, the information was posted on the bulletin board on board ship. The civil authorities were also notified. In later years it became customary to prohibit certain districts to naval personnel and post sentries to insure com-

U.S. NAVY

ADMISSION RATES PER 1,000, VENEREAL DISEASES COMBINED, BY YEARS — 1900 TO 1924.

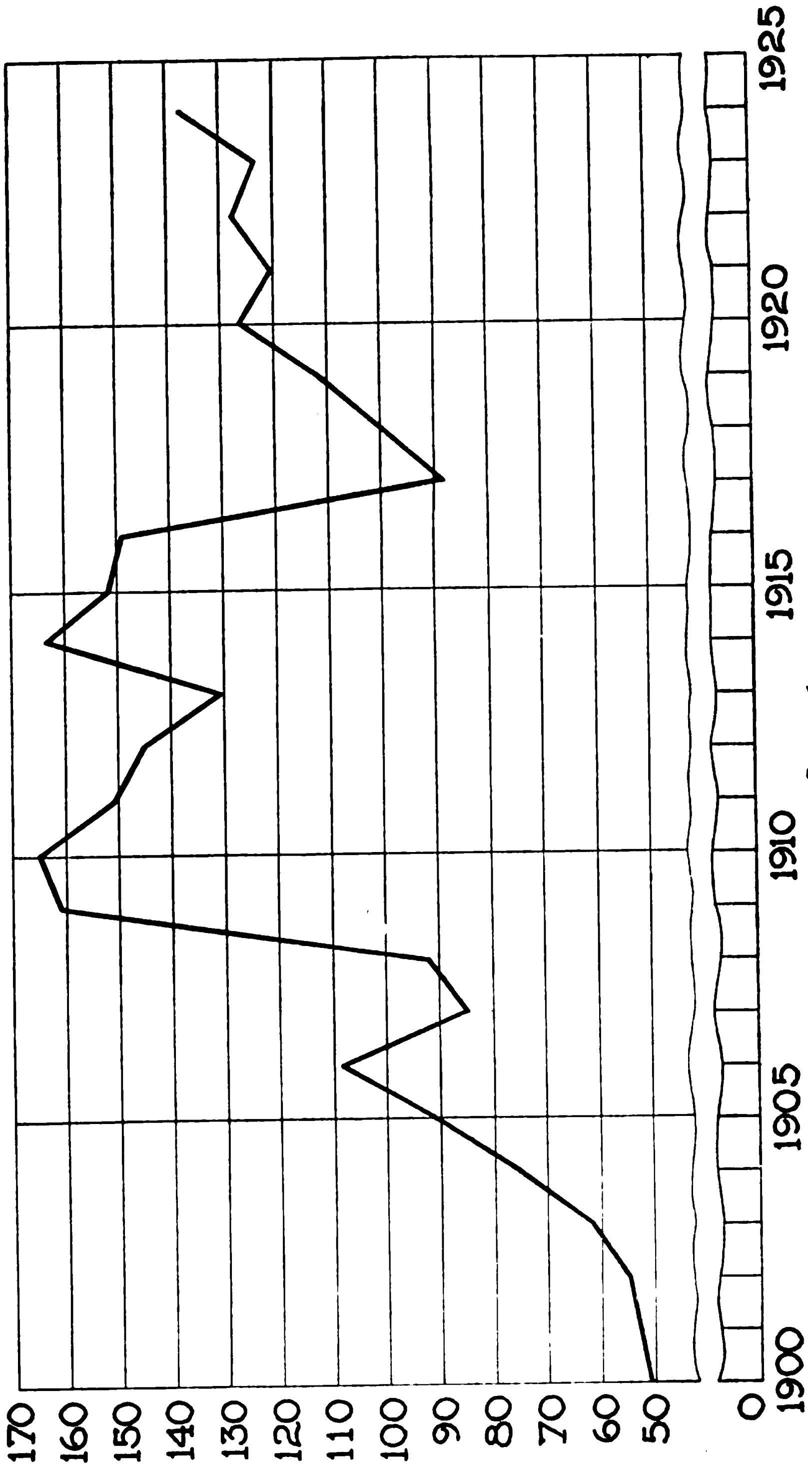

CHART 1

pliance. This measure fails to be completely successful because large liberty parties will induce the women to seek temporary quarters elsewhere.

Compulsory prophylaxis on return to the ship or station has been universally used. On some ships men have been required to answer "yes" or "no." Some hold the opinion that many a man would rather deny exposure than make public avowal of gross breach of morals. Coercive prophylaxis is considered less an affront to personal dignity. Those who have been exposed must voluntarily apply for treatment, and are subject to punishment if they develop venereal disease and have neglected to take prophylaxis.

Educational measures by means of lectures, literature, posters, slides, and motion pictures have been tried. Some believe that the "fear motif" limits the number of exposures per man, and, consequently, the chances of infection.

Information comparing the incidence of venereal infections among ships and stations has been issued monthly for some years by the Division of Preventive Medicine. This should keep medical officers alert to the situation and stimulate their zeal to greater efforts.

The Bureau of Navigation has put forth commendable efforts for the recreation and entertainment of the men. Navy chaplains and recognized welfare organizations have contributed a good measure toward improving morals.

Reduction in venereal infections falls far short of the results confidently looked forward to in the enthusiasm of 1909 and 1910. It may be that partial failure of realization is due to inability to work steadfastly toward the goal. A fleet circular issued to the Asiatic Fleet on May 4, 1923, states that the annual rate of admissions for venereal diseases (presumably in the Asiatic Fleet) had almost *doubled* in four years. In view of the apparent lack of attention to prophylactic measures, the order put in effect "a double prophylactic system," i. e., using both individual packets and ship's treatment. Men returning from liberty were required to answer "yes" or "no." A monthly routine inspection for detection of concealed diseases was put in effect. Venereal prophylactic reports were required monthly and the ships were placed "on a competitive basis regarding the occurrence of venereal diseases." This worthy effort in the Asiatic Fleet emphasizes that there is not always concerted effort in the Navy against venereal disease.

It is believed that more effort should be made to encourage the use of chemical prophylaxis on every ship and station of the Navy. This can be accomplished by aggressive measures by the commanders in chief, the district commandants, commanding officers, and medical officers. Reports on results attained should be submitted by every ship and station.

Articles published in the UNITED STATES NAVAL MEDICAL BULLETIN by medical officers from the beginning of systematic prophylaxis to the present time indicate that routine prophylaxis as practiced in the Navy is efficient against gonorrhea and syphilis if taken early enough after exposure. It is considered by most observers to be less effective against chancroid. Referring to this prophylaxis, which consists of intraurethral injection of a solution of an organic silver salt and the application of 33 per cent calomel ointment, Surg. C. E. Riggs, United States Navy, draws the following conclusion: "Artificial prophylaxis, to be effective, should be administered during the first or second hour after exposure; during the first hour it is practically infallible." (NAVAL MEDICAL BULLETIN, January, 1917.)

The following is quoted from "Notes concerning compound calomel ointment" in the UNITED STATES NAVAL MEDICAL BULLETIN for October, 1923:

The efficacy of 33 per cent calomel ointment in preventing luetic infection has been recognized since the publication of Metchnikoff's classic experiments in 1906. Less well known is the observation that an ointment of calomel and lanolin is, with the addition of certain ingredients, perhaps equally effective when applied intraurethrally in preventing Neisserian infections.

Much of the evidence in support of the assertion regarding the efficacy of the ointment in the prevention of infections of the mucosa is derived from published articles and from the experience of several naval medical officers. Principal reliance, however, has not been placed on statistics, since all comparative statistics are influenced by so many unknown factors and by so many recognized factors that can not be evaluated, but on authenticated experimental observations. The bureau has knowledge of 45 individuals, known to have been inoculated with gonococci, all of whom escaped infection by means of prophylaxis administered within a short time. In each case calomel ointment was the prophylactic agent employed.

Regarding silver preparations, the bureau knows of no such conclusive evidence bearing on their prophylactic action, and furthermore considers that their physical characteristics unfit them for use in self-disinfection.

It is scarcely to be expected that by thus affording men opportunity to shorten the period elapsing between exposure and the application of prophylaxis there will result a "zero" incidence in the venereal disease rate. There will always be men who, for one reason or another, will neglect protective measures, and even among those recorded as having availed themselves of the means afforded, absolute prevention of disease is unattainable—mainly for reasons such as—

(*a*) Records erroneous as to fact or time.
(*b*) Multiple coitus.
(*c*) Recrudescence of existing disease.
(*d*) Inefficient application of agents.
(*e*) Ineffectiveness of agents employed.

Consequently the most that can reasonably be hoped for is the attainment of an incidence of 0.8 per cent among those who have taken prophylaxis, 0.8 per cent being the "probability" figure when the time element alone is considered.

The purpose in thus enumerating the several causes possibly operative in preventing the attainment of ideal results is to call attention to the limitations inherent in any method of self-disinfection and to the consequent obligation to continue active instruction in physiology and ethics.

(a) Maus. Jour. Mil. Surg., 1910, XXVII, p. 264.
(b) Maus. Jour. Mil. Surg., 1910, XXVII, p. 636.
(c) Russell and Nichols. Jour. Mil. Surg., 1912, XXXI, p. 214.
(d) Bachmann. Jour. Mil. Surg., XXXI, p. 192.
(e) Personal communications.

In discussing intraurethral injections of strong protargol solutions in prophylaxis, Passed Asst. Surg. W. J. Zalesky stated: "To use any drug that has irritating qualities and causes pain is decidedly disadvantageous. Men will not report as freely or give their cooperation in treatments that give pain. This in itself is a very important factor, as it is necessary to use as painless a method as possible." (Naval Medical Bulletin, January, 1910.)

In addition to the usual prophylactic facilities on board ship, first-aid stations with facilities also for prophylaxis might be established ashore whenever ships send large liberty parties, especially if the ships are at some distance from the city.

Concealment of disease is doubtless fostered by the provision of law which takes away the pay of personnel absent from duty as the result of disease due to misconduct. It seems harsh to penalize men urged by primal instincts. It should also be considered that thus far it has not been possible to offer a sure preventive treatment.

The restricted list also engenders concealment, not so much in home ports, perhaps, as abroad. The men, having joined the Navy "to see the world," are tempted to conceal infection in order to realize their ambition. It is, of course, unwise to allow persons in an acute, infectious stage indiscriminate liberty. This would be unjust to civilians as well as our own personnel as a source of further infection. It is suggested that if restricted men were allowed to go in sight-seeing parties and to entertainments in charge of an officer or responsible chief petty officer there would be less concealment and unhappiness.

Although prophylaxis might be optional, the individual should not escape punishment if he develops infection and it is proved that he failed to take prophylaxis. Evasion of punishment might be more difficult if all men when they apply for prophylaxis were to be examined. If the men were to place their initials in the prophylactic book instead of names, it would give them an added assurance that this book is confidential. This method has been used by several medical officers. Loss of pay, it is believed, should not be deducted from allotments to dependents.

Education should be continued by medical officers, emphasizing the prevalence and danger of venereal diseases, but by no means neg

lecting to explain in detail the application of chemical prophylaxis and the use of immediate preventive measures such as condoms and individual packets. Application of prophylactic ointments *before* coitus has been advocated by a number of authorities for many years, and it is believed that the men should be particularly instructed as to this detail. Medical officers of long experience believe that chemical prophylaxis should be offered and encouraged without any promise or guaranty of safety but as the only hope of protection, which is a duty the individual owes to himself and to the service.

In the 10 years from 1914 to 1923 there were 187,665 admissions for venereal disease in the Navy. With practically every seventh man in the Navy now infected in the course of a year, it becomes important to concentrate efforts to combat infection.

It would be interesting to see what might be accomplished in reducing incidence of venereal infection through the cooperation with medical officers of all officers controlling personnel.

SYSTEMATIZATION OF DENTAL TREATMENT IN THE NAVY

By W. Rehrauer, Lieutenant, Dental Corps, United States Navy

The practice of dentistry in the Navy seldom can be carried on in all of its phases according to the standards and teachings of our colleges and as advocated by civilian study clubs and dental associations. This is due in great measure to the fact that the number of dental officers available is not sufficient to meet the large and increasing demand for dental service. Therefore it becomes the duty of every naval dental surgeon to seek and adopt ways and means whereby the greatest possible number of our patients may be given early and efficient treatment of a quality equal to or better than the best civilian standards.

The writer believes that, due to the constant pressure for time under which the naval dental surgeon operates, the ratio of temporary treatment to all treatment performed is too large. By performing so-called emergency operations in as permanent a manner as possible this condition can be eliminated almost entirely, and a surprising reduction in the number of cases requiring pulp extirpations, root-canal treatments, and extractions can be effected.

The majority of our patients are young and have a high degree of resistance, and pulp conservation can be practiced with an astonishing measure of success. If our patients are handled properly during their original or emergency visits, with a view toward performing every possible operation along lines of permanency, a great number of root-canal treatments will be eliminated. The average patient will be benefited decidedly, and the dental surgeon will be

enabled to undertake many additional permanent restorations during the time saved.

Permanency of the first or emergency treatment is assured in many cases by the use of temporary or permanent cements and pastes such as the combination of zinc oxid and eugenol. The use of temporary stopping should be restricted to its proper sphere—that is, where only a temporary result is desired. Sandarac varnish and cotton have a decidedly limited field in operative dentistry.

After having studied the problem during a period of three years, while performing duty on board battleships with complements of never less than 1,300 persons, the writer is convinced that system and standardization, applied to dental practice, will produce wonderful results. During the period mentioned many plans were studied, and the one to be set forth in this paper seems to have given the best results on board a large vessel, where the dental surgeon always is pressed for time.

The plan to be elucidated consists of a system of handling the routine of daily practice and a standard of operations to be performed and materials to be used.

The system consists of a definitely established routine for the management of dental activities, such as keeping regular hours, preparing dental abstracts when necessary, making necessary entries upon the abstracts and in the appointment book and its index, and designating and supervising the duties of the assistant to the dental surgeon.

Standardization is applied to dental operations and to the materials used therein. For the purposes of this article, reference is made especially to types of treatment which have to do with caries, pulpitis, putrescence, abscesses, and various other conditions. In performing so-called emergency operations on these types of dental disease, system and standardization, with the idea of permanency constantly in mind, will aid the dental surgeon to handle successfully the problems with which he is confronted.

Under the heading of system, office hours must be considered. The writer, during the period of study previously mentioned, fixed his hours from 8.30 a. m. to 12 noon and from 1 to 4 p. m. daily, except Saturday, Sunday, and holidays. Office hours ended at noon on Saturday, and on Sunday and holidays the dental surgeon was subject to call if an emergency case presented itself.

The hours mentioned were assigned as follows:

From 8.30 a. m. to 9 a. m., emergency dental treatments. This period coincides with the medical sick-call period, and patients appear to have painful conditions treated, to arrange appointments, or for consultation.

From 9 a. m. to 12 noon, appointment time. During this period restorative treatments are performed for individuals who have been given appointments.

From 1 p. m. to 1.30 p. m. emergency dental treatments.

From 1.30 p. m. to 3.30 p. m., appointment time.

The brief period from 3.30 p. m. to 4 p. m. is utilized to complete the preparation of dental abstracts, to make entries in the index of the dental appointment book, and to give attention to any other similar matters of routine nature. At this time the assistant begins his task of cleaning the operating room and preparing the equipment and materials for use the next day.

Schedules of treatment hours may be posted on bulletin boards throughout the ship in order that they may be known to the officers and men. It is virtually impossible to prevent the condition whereby a few individuals will, on account of duties peculiar to the naval service, present themselves for emergency treatment outside of the periods set aside for such treatment. These cases should be cared for as promptly as possible between appointment cases. Each appointment for restorative treatment is made for one hour, and the completion of such treatments within the allotted time permits the handling of emergency cases. Should a certain operation be completed well within the hour and no interruption occur, another operation should be commenced and carried as far as possible toward completion. It should be borne in mind that lack of time is the factor which gives rise to many of our problems and, in order to handle the situation at all satisfactorily, intensive operating must be done during the hours devoted to treatment.

It is of paramount importance that the dental officer keep his office hours in person, and that he keep them consistently in order to eliminate confusion. Unless the system operates smoothly, standardization will be an impossibility. Promptness on the part of the dental officer instills confidence in his patients and invites their cooperation, which is a very necessary factor in naval dental practice. Promptness and regularity also have a salutary effect upon the dental surgeon himself.

Applicants for treatment who are not suffering pain, or for whom immediate treatment does not appear to be necessary, should be given appointments. If the appointment book is filled for some time in advance, names may be added to a waiting list. Each man whose name appears on the list is notified as soon as his treatment can be undertaken.

Appointments are made for not more than one week in advance, so that a patient may receive at least one sitting a week. The scheme is, in general, to accomplish permanent restorative treatment for each patient who receives an appointment and to continue to assign appointments until all necessary treatment has been com-

pleted. A patient who has been treated in this manner will require no further attention for a long period. It has been noted that men whose teeth have been restored to health appear to be improved in many respects, and that they take pride in their efforts to maintain oral health. Such men usually show increased efficiency in the performance of their duties, their sense of well-being is stimulated, and they take added interest in personal cleanliness. The definite physical benefit which results from the ability to masticate properly can not be overestimated.

Upon the completion of operative treatment for the day, the dental officer makes all necessary entries upon the dental abstracts and in the index of the appointment book. Notes of treatment performed during the day are made on a rough Form K–Dental. Entries on the dental abstracts should be accurate and legible, and all abbreviations used should be strictly in accordance with instructions.

Patients who are suffering pain or discomfort should be given attention as soon as possible after they have presented themselves for emergency treatment. It is at this point that standardization of treatments and materials must be considered.

Standardization is applied to emergency operations with the view of making these operations as nearly permanent as possible in the time available. The majority of emergency treatments are rendered to relieve pain caused by pulp irritations or inflammations, root-canal infections, and abscesses. There is a lesser incidence of cases in which inconvenience and discomfort are caused by the lodging of food particles in carious teeth. All of these are types of conditions to which reference has been made and for the treatment of which this system of standardization is recommended.

As a part of the system of standardization, a classification of the conditions more commonly found may be set down as follows:

Class 1.—Cavities with no pulp irritation or inflammation from which all decay apparently can be removed without involving the pulp.

Class 2.—Cavities with pulp irritation or inflammation from which all decay apparently can be removed without further injuring or exposing the pulp.

Class 3.—Cavities from which all decay apparently can be removed and in which the pulp is exposed but where there appears to be a good chance for pulp conservation.

Class 4.—Cavities from which all disintegrated tooth structure can not be removed without exposing the pulp but where a small amount may be left with a reasonable chance of not destroying the pulp later.

Class 5.—Cavities in which the pulp is slightly exposed and all disintegrated or discolored tooth structure can not be removed without further endangering the pulp but where the chances for conserving the pulp are reasonably favorable if the disintegrated dentine which is allowed to remain and the exposure are treated properly.

Class 6.—Cavities in which it is certain that pulp extirpation will be necessary.

Class 7.—Cavities in which the contents of the pulp chamber or root canals are putrescent but where there is no apparent disturbance beyond the root apices and no pus present.

Class 8.—Cavities in which there is putrescence in the pulp chamber or root canals and where there is disturbance beyond the root apices but no pus present.

Class 9.—Cavities in which there is pus in the pulp chamber, root canals, or beyond the root apices.

The treatment of the conditions classified in standardized and a very limited number of agents is used. This number includes permanent cement, temporary cement, zinc oxid, eugenol, dentalone or oil of cloves, silver nitrate, formo-cresol, and temporary stoppings. The agents used under a standardized system should be limited in number, and those enumerated would seem to be sufficient. They can be manipulated rapidly, and this property is especially important under the conditions.

Zinc oxide and eugenol are combined to make a thick paste. If it is desired to use silver nitrate in combination with this paste a very small amount of the crystals is incorporated in it. It has been noted that the addition of silver nitrate to zinc oxide and eugenol paste hastens the setting of the mixture.

In treating all of the above classified conditions the first and most important step is to remove as much decay as possible. No effort is made at the first sitting to prepare a cavity of ideal shape, and no attention is paid to frail walls, which are left undisturbed. The tooth is isolated with cotton rolls, the cavity carefully dried, and the proper treatment applied. In the event that root canal treatment is necessary, the rubber dam always should be applied at the commencement of the operation and aseptic precautions observed.

After the disintegrated tooth tissue has been removed the treatment for each of the conditions classified is as follows:

Class 1.—Permanent cement is inserted.

Class 2.—If an acute condition exists, the cavity in the region of the pulp is swabbed with a minute quantity of eugenol, dentalone, or some similar sedative, or a small quantity of zinc oxid and eugenol paste is inserted before the cavity is closed with permanent cement.

Class 3.—A very small amount of zinc oxide and eugenol paste is carefully placed over the exposure and the cavity is closed with permanent cement.

Class 4.—A very small amount of silver nitrate crystals is incorporated thoroughly with the zinc oxide and eugenol paste, which is placed so as to cover all remaining disintegrated or discolored tooth structure. The cavity then is closed with permanent cement. In a condition of this class the silver reduction method can be used if time permits, or copper cement may be used without the application of silver nitrate.

Class 5.—A minute quantity of silver nitrate crystals is added to zinc oxid and eugenol paste, which is placed over the pulp exposure and discolored dentine. The cavity then is closed with permanent cement. This procedure will be successful in the majority of cases, although in a small number of cases the patients may experience slight tingling sensations or a few paroxysms of pain due to the irritant properties of the silver nitrate. The unpleasant sensation soon will pass off and, as a rule, no further trouble will be experienced.

It will be noted that permanent cement is used in all of the treatments enumerated above. The completion of these cases, therefore, can be delayed and the names of the patients can be placed on the waiting list. When such a case again comes up for treatment the cement filling may be used as a base for a filling of another material. The presence of permanent cement in a tooth upon the reappearance of a patient apprises the operator that the tooth is ready for permanent restoration.

Much time can be saved by following the methods described. In addition, pulps are protected and pulp conservation really is practiced. After a short experience with these methods the reduction in the number of pulp extirpations and treatments of putrescent and abscessed teeth becomes strikingly noticeable.

The five classes of conditions which have been discussed usually require no further treatment, but such is not the case in dealing with the remaining four classes, which are treated as follows:

Class 6.—A very small pledget of cotton saturated with a sedative is placed over the pulp and the cavity is closed with pink temporary cement. As a result of closing a cavity of this class with temporary cement, the pulp usually will remain vital until removed; whereas, with such cavities closed by means of temporary stopping, sufficient protection is not given and putrefaction follows. In many cases, when temporary stopping is used, the patient must return for renewal of the treatment on account of pain caused by pressure.

Class 7.—In this class of conditions as much of the putrescent root canal material as possible is removed by means of barbed

broaches, great care being exercised to avoid pushing the broach or any infected material through the apical foramina. Engine root-canal instruments never should be used in this class of cases. After all possible material is removed from the canals a small quantity of formo-cresol is introduced into each canal by means of a bibulous paper point, which is left in the canal. Care should be exercised to avoid pushing the point through the apical foramen. A small pledget of cotton is placed in the pulp chamber and the cavity is closed with pink temporary cement.

Class 8.—The same procedure is followed as in class 7, except that the bibulous points also are impregnated with a sedative in combination with formo-cresol, the former agent often tending to counteract the irritant properties of the latter.

Class 9.—In this class of cases, the canals are cleaned out thoroughly by means of barbed broaches and root-canal files and as much pus as possible drained. The canals then are washed and drained. Bibulous paper points which have been dipped previously in formo-cresol are placed in the canals as far as possible without passing through the apical foramina. A pledget of cotton is placed upon the floor of the pulp chamber and the cavity is closed with pink temporary cement.

In classes 6, 7, 8, and 9 it will have been noted that pink temporary cement is used. The color of this cement immediately warns a future operator that further treatment is necessary before permanent restoration can be effected. Permanent cement always should be used in classes 1, 2, 3, 4, and 5. The use of the permanent and temporary cements, as indicated, requires no more time than the use of temporary stopping and insures a more satisfactory result.

The writer is aware of the arguments advanced in favor of and against the use of formo-cresol, but, after having observed its therapeutic effects in a large number of cases, believes that it will do all that is claimed for it if properly used, especially in the treatment of the types of cases to which reference has been made and under the conditions of naval dental practice.

It is realized that the methods of system and standardization which have been described are not perfect, but it must be borne in mind that they are advocated only in relation to special lines of treatment and to meet the peculiar conditions which attend the practice of dentistry in the Navy. As a result of his studies, the writer has noted the following advantages and benefits to be derived from system and standardization:

1. The virtual elimination of repetitions of treatments.
2. The conservation of many vital pulps.
3. A reduction in the number of pulp extirpations.

4. A reduction in the number of gangrenous and abscessed conditions.

5. A reduction in the number of teeth extracted.

6. A surprising amount of time saved due to the decrease in the number of repeated treatments, pulp extirpations, gangrenous and abscessed conditions.

7. Less gingival inflammation due to pressure such as may be caused by the forcing of temporary stopping against the gingival tissue

8. Less physical and mental strain on the operator.

9. The operator knows at a glance approximately what condition is present under a filling material, especially if the entries in the dental abstract are accurate, and much unnecessary conversation is eliminated.

As a result of this study, an interesting collateral fact has been deduced. By using the system and standard outlined, 33 individuals can be given one-hour appointments each week, in addition to an allowance of time for emergency cases. During the entire period of three years over which this study extended the waiting list included an average of 156 names of individuals who were waiting to receive appointments for permanent restorative treatment. The figure obtained by dividing 156 by 33 demonstrates that four additional dental surgeons could be fully occupied in caring for the personnel of each battleship having a complement of 1,300 or more, and that there still would be a continuous waiting list of 24. When it is remembered that the figures given represent only persons who present themselves for dental treatment voluntarily it will be understood that the estimate given is quite conservative.

An attempt to determine the extent to which the efficiency and morale of the naval personnel would be improved by a thorough and general repair of the teeth would constitute a very interesting study.

SOME OBSERVATIONS ON RECRUITING

By L. B. Marshall, Lieutenant, Medical Corps, United States Navy

To write an article on recruiting duty seems superfluous. It would appear that everyone in the service considers that he knows all about recruiting and that nothing can be added to what is already known. There is, however, more to recruiting than a nonexperienced individual realizes.

In considering this subject I like to think of the duties of a recruiting medical officer in the following terms:

(A) Recruiting for the regular service.

(B) Examinations of United States Naval Reserve men.

(C) Examination and classification of Fleet Naval Reserve men.

(D) Examination of civil-service men and C. M. T. C. men.

(E) Miscellaneous, including medical surveys, securing supplies, obtaining civilian medical and dental treatment for personnel, etc.

(F) Clinical work and postgraduate instruction.

(A) Recruiting for the Regular Service

It has been well said that the recruiting officer is a watchdog of the Treasury, and this is particularly applicable to the medical recruiting officer, for on him rests the burden of acceptance or rejection of applicants. The Navy Regulations require a most thorough physical examination, plus references showing the man to be of good character, evidence of citizenship, etc. The physical requirements are laid down in the Manual of the Medical Department and all officers follow these regulations, differing one from another only in the method of examining the candidate. We have found the following method the best and most satisfactory in this office.

The applicant makes out his application on the form provided, taking particular care to fill out the blank correctly and fully, for all of the data for the health record must be obtained from the application blank. The applicant is then brought into the examining room and his vision first tested, using 20/20 as normal, with the Snelling test chart. Color vision comes next, using Jennings' self-recording set or Stilling's pseudoisochromatic plates. The hearing is then tested, using the voice and watch tests, and the drums and canals are examined with the aural speculum. Mouth and throat are then examined for defects and abnormal conditions and the teeth are charted. Sinuses are examined and the reactions of the eyes noted.

The applicant then strips completely and height, weight, and chest measurements are recorded. He then stands under a strong light facing the examiner and the "looking over" begins. Examine the head, noting contour, evidence of injury, etc.; the eyes, for any abnormality; neck, for abnormal thyroid or enlarged glands; chest, for deformities; arms and hands, for abnormalities; abdomen, for scars, hernias, rash, etc.; inguinal region, for hernia or enlarged glands; femoral regions, for hernia; penis, for abnormalities, scars, or any evidence of disease; scrotum, for varicocele, hydrocele, or atrophied, missing, or undescended testicles; thighs and legs, for abnormal conditions; feet, for hammer-toes, bunions, large corns, webbed toes, or any other congenital deformities.

The applicant then turns his back to the examiner and muscular development is noted. The spine is examined for curvature, tenderness, or pain. Hemorrhoids are looked for; then varicose veins.

The condition of the arches of the foot, whether normal, depressed or flat is noted. The applicant is then put through a series of exercises to demonstrate the mobility of his joints and the absence of ankylosis or any condition that limits the joint function.

The marks and scars are then recorded.

The chest examination comes next, the usual chest examination being made.

The pulse rates before exercise, immediately after, and three minutes after are recorded. Blood pressure is recorded before exercise.

The history of the applicant is gone into as thoroughly as conditions permit. He is questioned closely and carefully concerning previous diseases and injuries, such as scarlet fever, rheumatism, tonsilitis, epilepsy, bed-wetting, use of drugs or alcohol, or any abnormal chest or abdominal condition, accidents, etc. He is rejected if there is any suspicion that some previous condition will have a bearing on his naval career.

Urinalysis is reserved to the last. We record the specific gravity; presence or absence of albumin, using heat and acetic acid; and presence or absence of sugar, using Fehling's test. It has been noted in a previous paper that some of these applicants show albumin on the first examination and not on subsequent examinations.

During the course of the examination the mental attitude of the applicant can be obtained and considered in the final summing up of all the data, resulting in acceptance or rejection.

No man showing tachycardia or albumin is rejected on one examination alone. The applicant is asked to return and be reexamined, not once but several times, until it is proved conclusively that the condition is pathological and not transient.

Such an examination as outlined above will take from 30 to 45 minutes, depending upon the skill and speed of the examiner. As he obtains experience the examination can be cut down, but it usually takes about 30 minutes for a satisfactory examination. It has been noted that the majority of our rejections are because of defective teeth, defective vision, flat feet, and underweight, the other causes for rejection being smaller in number.

The medical examiner must pay particular attention to the teeth. Men have been accepted and enlisted only to be discharged from the training stations for defective teeth. It is considered that teeth have been stressed too much in certain instances and men have been discharged when it was really unnecessary. It is a source of grief, dissatisfaction, and often embarrassment to the medical examiner to accept a man whose teeth, while not in the best condition, appear satisfactory and meet requirements as nearly as we can judge and

then have that man rejected at the training station when a little work would give him a satisfactory mouth. Often, too, the fact that the third molars have not erupted is not considered. It is believed that the lines of acceptance and rejection are being drawn too fine and that some good men are being discharged unnecessarily. Teeth are, without doubt, most important factors in a man's general health and his working ability, and it is not favored to lower requirements as they now exist, but more leeway should be given and the regulations should not be interpreted too literally. It is believed, too, that a number of men have been rejected at training stations for deficient vision when a little care and patience, such as is often used in the recruiting stations, would show that the recruit could read the letters satisfactorily. The light on the letters should receive attention, also the fact that the man may have come from a brilliant sun outside and is then asked to read the letters and is unable to so. He should be given time to adjust himself. Malingering must be considered here. The recruit knows from his examination at the recruiting station that he has some eye defect, and he may purposely fail to read the test letters so that he may be discharged. All the more reason for a careful, patient examination.

(B) Examination of United States Naval Reserve Men

The examination of Naval Reserve officers and men makes the next big demand upon the recruiting medical officer. Under the present reserve bill there are practically four classes in the reserve: Fleet Reserve, Volunteer Reserve, Merchant Marine Reserve, and Aviation Fleet or Volunteer Reserve. In this office there is just as much work in examinations and paper work for the Naval Reserve as there is for the regular service; sometimes there is even more. There is too much paper work, and in some way it should be cut down. In my files are records of about 100 Naval Reserve officers some of whom have been examined by me as many as six times in a period of 8 or 10 months. The regular service only requires, ordinarily, one examination a year for its officers, but every time a Naval Reserve officer turns around he must have a physical examination. There are examinations for enrollment, reenrollment, training duty, release from training duty, promotion, transfers, and what not. Each examination, so far as the physical is concerned, requires that the same identical report be made out and forwarded and the same physical examination be gone through with each time. The files of the bureau and various commandants must be cluttered with useless reports, because they are, in a large majority of cases, merely repetition. The Naval Reserve should be placed on a secure working foundation, and then each officer appear once a year before a qualified medical examiner or medical board, the proper examination

and reports made and forwarded. Another examination should not be necessary except for promotion or when there is reason to suspect some intervening disease.

The medical recruiting officer should act more in an advisory capacity toward the reserve rather than have all the actual work go through his office. It is admitted that in many cases the reserve medical officers were very lax and careless in their examinations, which was the reason for transferring the work to the regular recruiting medical officer; but each reserve doctor could be held strictly accountable for his work, and in all probability the majority of doctors would be conscientious and carry out their duty satisfactorily.

The Aviation Reserve examination entails a double report—one made on the regular flight physical form and the other made on M. & S.P–2–5/EN–10. In this area the regular recruiting medical officer is the senior member of the flight examining board, the other member being a reserve medical officer designated as flight surgeon. This reserve medical officer is an eye specialist and has had enough training as flight surgeon to make his work most acceptable to the commandant and the bureau. The arrangement has worked very satisfactorily. This is only another phase of work that may fall to the lot of the recruiting medical officer and which might just as well be handled by reserves. A certain designated reserve medical officer could receive flight training during his periods of active duty each year. An eye specialist should be selected, for his training will not take nearly the time nor effort that would be required to train a man not a specialist. The board could then be convened by the commandant and be a permanent board. In those areas where a regular medical examiner is not available reserve officers have to make trips to the nearest one, entailing loss of time and an expense that must be borne by the individual. Whenever the regular medical officer is ordered away without a relief or when he goes on leave, the Naval Reserve is at a standstill so far as its physical examinations are concerned.

It is firmly believed that each Naval Reserve unit should be self-sustaining in every way and that all work pertaining thereto should be handled by Naval Reserve personnel.

(C) The Examination and Classification of Fleet Naval Reserve Men

This year in each district all Fleet Naval Reserve men were examined and classified as to whether they were fit for sea duty, shore duty only, or no duty at all. Twenty-six men reported to this office from Minnesota, North Dakota, and Wisconsin. The proceedure required a complete physical examination and a report made to the

commandant of the man's physical condition. This same procedure will be, probably, carried out every two years, or maybe every year, thereby adding to the work of the recruiting office.

(D) The Examination of Civil-Service Men and C. M. T. C. Men

Under recent orders from the Treasury Department, civil-service applicants must have a complete physical examination and every recruiting medical officer received, presumably, orders to examine these applicants whenever they should appear and request examination. There have been quite a number examined in this office, exactly how many is not known, for we have no occasion to keep a record and the civil-service examination blank is only in the original. Not many C. M. T. C. men were examined in this office, because of the proximity of Fort Snelling, but, had the fort not been here, quite a large number would have passed through this office. In addition, cowpox vaccination and antityphoid prophylaxis is to be instituted should it be requested by the area commander.

(E) Miscellaneous

In this connection reference is made to the procurement of supplies, care of personnel of the station and their families, surveys of material and personnel, supervisory boards for examination for promotion, explanation of the Medical, Dental, Nurse, and Chaplain Corps to interested individuals, and civilian medical and dental care for the personnel. In the latter case the medical officer must be very careful or he will get into trouble.

(F) Clinical Work

From the preceding it would seem that the medical officer on recruiting duty has very little time to devote to outside interests. Such is not the case, however, and it has been found that two mornings a week can be devoted to a clinic at the general hospital and one or two mornings to special work in urology without detracting from the usual work in the recruiting office or working any undue hardship on the office personnel. While it is not an established order the bureau expects the medical officers, whenever possible, to take advantage of the opportunities to attend clinics and schools. In most large cities the medical officers can get a lot of useful information and study which is to their advantage as well as the Navy's.

At this point it may be suggested that a few lectures on recruiting could well be given at the Naval Medical School. These lectures would be well worth while and prove of an immense benefit to the medical officers who have had no recruiting duty. It is not known if any such lectures are given at the school but, if not, it is believed

that it would be a good plan to give three or four lectures which would cover the subject amply. Many things come up in recruiting that may not be met with ordinarily, and the medical officer has to fight these things out himself. Sometimes he is right, often he is wrong, and if he had had a little instruction he could go out feeling much more capable of carrying out his recruiting work in a satisfactory manner. There is much more to recruiting than the mere examination of men's bodies.

In drawing to a close it is not desired to leave the impression that there is too much work nor that a complaint and kick of any sort is being registered. But it is believed that there are better ways of handling some of the work, and this paper is written in that spirit. Recruiting is neither hard nor unsatisfactory duty. There is plenty of joy and plenty of grief. The medical officer must be more than careful in everything he does, and if he approaches his work in the right spirit he will find recruiting duty enjoyable and instructive and he will be able to return to other naval duties without the feeling of having "lost" while he was away.

THE LANGE COLLOIDAL GOLD REACTION

By R. B. H. Gradwohl, Lieutenant Commander, Medical Corps, United States Naval Reserve

This is an extremely valuable differentiating test of spinal fluid. It probably has its greatest field of usefulness in differentiating general paralysis of the insane or "paresis" from all other disturbances of the central nervous system. This solution gives what is known as characteristic "curves," differentiating one kind of anatomicopathologic change in the nervous system from other kinds. Characteristic "curves" are spoken of as occurring in paresis, lues (cerebrospinal syphilis), tabetic affections, meningitis, and normal conditions. The most definite "curve," we repeat, is found in paresis. Chemically, the test is a test for globulins and albumin in the spinal fluid. Clinically, it is a test of corroborative value in making the diagnosis of neurosyphilis.

The physicochemistry of the whole test depends upon the fact that colloids, for instance, very small quantities of gelatin, will protect gold solutions from the action of electrolytes. Zsigmondy determined the amount of protection for gold solutions possessed by colloidal substances and gave them what he calls a "gold number." By "gold number" we mean the number of milligrams of the colloid which is sufficient to prevent the change to violet of 10 cubic centimeters of bright red colloidal gold of a percentage of 0.0053 by the addition of 1 cubic centimeter of 10 per cent sodium chloride solution.

Lange found that 0.4 per cent solution of sodium chloride keeps globulins in solution and in itself would not cause any change in colloidal gold solutions. Spinal fluid from paretics not only does not protect the gold but actually causes its precipitation. Upon this fact is built the differential test.

Before going into the facts of interpretation we shall discuss a most important point about this test—namely, the manner of preparation of the colloidal gold and the preparation of the glassware for the test.

There are many ways of making the solution, and all laboratory workers who have used this test will admit that at times serious difficulty has been encountered in making it. The fault in making and developing the proper color has been laid at the door of imperfectly chemically cleaned glassware, the formalin solution, the gold solution, the potassium carbonate solution, and the fact that the water was not triply distilled. The writer has tried every method and followed every precaution. As a result of his experience, he gives the following technique which gives one the maximum of successes, although at times failure even with this method may and does occur:

First. Use doubly distilled water. If you can get triply distilled water, use it, as this helps to eliminate the difficulties. Have on hand at least 2,000 cubic centimeters of this distilled water; 1,000 cubic centimeters is needed for actually preparing your solution, the other 1,000 cubic centimeters may be used in making up your solutions and rinsing the glassware.

The solutions needed are:

Gold chloride solution, 1 per cent.

Potassium carbonate, 2 per cent.

Oxalic acid, 1 per cent.

Formaldehyde, use 2.5 cubic centimeters of formalin to 200 cubic centimeters of water.

Have on hand about 3 liters of this solution. It is highly useful in laboratories for cleaning glassware.

Glassware required:

A 1,000 cubic centimeter dark-colored, glass-stoppered bottle for storing the colloidal gold after it is prepared.

One beaker, 1,000 cubic centimeter capacity, free of scratches.

One 1,000 cubic centimeter graduated measuring cylinder.

One chemical thermometer registering to 100° C.

Two 10 cubic centimeter pipettes, graduated in 1 cubic centimeter divisions (one for the gold chloride, one for the potassium carbonate).

Four 1 cubic centimeter pipettes, graduated in tenths and hundredths, graduated to the tips.

One 5 cubic centimeter pipette.

Eleven test tubes, lipless, heavy glass, size $\frac{11}{16}$ by $\frac{3}{4}$ by 6 inches. After using, they are to be rinsed in tap water and immersed overnight in a 1 to 10 dilution of aqua regia (seven volumes of concentrated hydrochloric acid to two volumes of concentrated nitric acid). This dissolves any precipitated gold which is difficult to remove ordinarily.

Keep this glassware together after using, and use it for no other laboratory purpose. If you are to make more than one Lange test, you need 11 tubes for each fluid; hence, it might be well to prepare more than 11 tubes.

Points to be Remembered

The gold chloride comes from the dealer in small ampoules. While these may be marked "1 gm." remember that this is not always accurate and that you must weigh the contents accurately in order to make your 1 per cent solution. The potassium carbonate and the oxalic acid keep fairly well; the formalin does not. It is a good idea to make up all these solutions with your doubly or triply distilled water and to keep them in the dark, particularly the gold-chloride solution.

The Making of the Colloidal Gold Solution

First clean the glassware by pouring 1 liter of the cleaning solution into the 1-liter beaker, place this on a sheet of asbestos mat and heat over free flame, boiling same from 5 to 10 minutes. Place all your glassware in the 1-liter graduate and pour this boiling bichromate solution over it. After allowing it to remain in contact with the glassware 10 minutes, pour the bichromate back into the storage bottle, since it can be used over and over again. Rinse the beaker and the glassware, still in the graduate, with running hot water, followed by free rinsing with distilled water. Drain the water off the glassware by tilting the graduate. Pour 1 liter distilled (doubly or triply) water into the clean beaker, placed on a tripod covered with a large asbestos mat so that the free flame will not come in direct contact with any particular spot on the bottom of the beaker. Add to the water 10 cubic centimeters, gold-chloride solution (1 per cent), 7 cubic centimeters 2 per cent potassium carbonate, 1.75 cubic centimeters of 1 per cent oxalic acid, and 0.83 cubic centimeter of formalin solution. Mix thoroughly, dip thermometer into the beaker, cover top with a piece of clean glass or watch glass, and heat with free flame.

The heating will gradually develop a play of colors, and, dependent upon the development of these colors, will determine whether or not you have made a useful colloidal gold. When the water gets to about 60° C. you will note a faint blue-green color, then lavender as the mixture gets hotter, then pale pink, pink at about 80° C., then violet and then deep red, this occurring at about 85° C. Just about this time, if all is going well, you will note a sudden lightening in color, a transition from deep to a lighter red. At this point turn off the flame; this is usually around 85° C. If this transition does not occur, the solution is of no use and must be rejected. Allow to cool and then use.

The Test Proper

Shall the spinal fluid be fresh?—This is not essential, since we have made Lange tests of fluid from a distance and obtained excellent results.

Rack up your 11 test tubes in a wood or metal rack. Put in the first 1.8 cubic centimeters of the 0.4 per cent saline solution; the others receive 1 cubic centimeter each. To tube No. 1 add 0.2 cubic centimeter spinal fluid, washing the pipette thoroughly with the mixture. This is very important. One cubic centimeter of the mixture is transferred to tube No. 2 and mixed, and so on down the line, repeating the procedure down to and including the tenth tube. The extra cubic centimeter from the tenth tube is discarded. Add 5 cubic centimeters of colloidal gold solution to each of the 11 tubes. Tube No. 11, of course, is the control. Shake thoroughly. You should read in a preliminary way at the end of one hour, and finally, after the tubes have stood overnight.

The play of colors which occurs where the gold is unprotected has been given numbers. The report below indicates the numbers and their color, and the various tubes indicate the dilutions just described.

Interpretation of Results

The paretic zone.—Here the greatest reaction is in the first three to six tubes and is of the 5 type. The color rapidly falls in the succeeding two or three tubes to 0.

Luetic zone.—Here the greatest color change is in the fourth and fifth tubes, but it is never greater than 4 or less than 3.

Meningitic zone.—The maximum color change occurs in the higher dilutions, beginning with the sixth tube.

Facts to be Remembered About the Lange Test

1. Its greatest usefulness is in cases where we get a paretic zone curve in those cases of syphilis of the central nervous system wherein

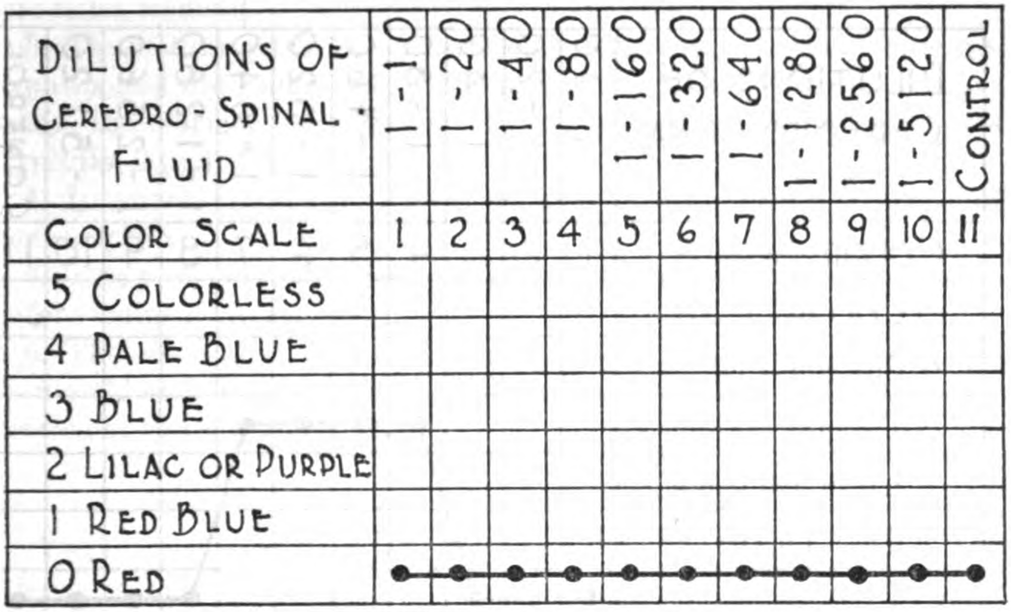

CHART 1.—Normal zone curve

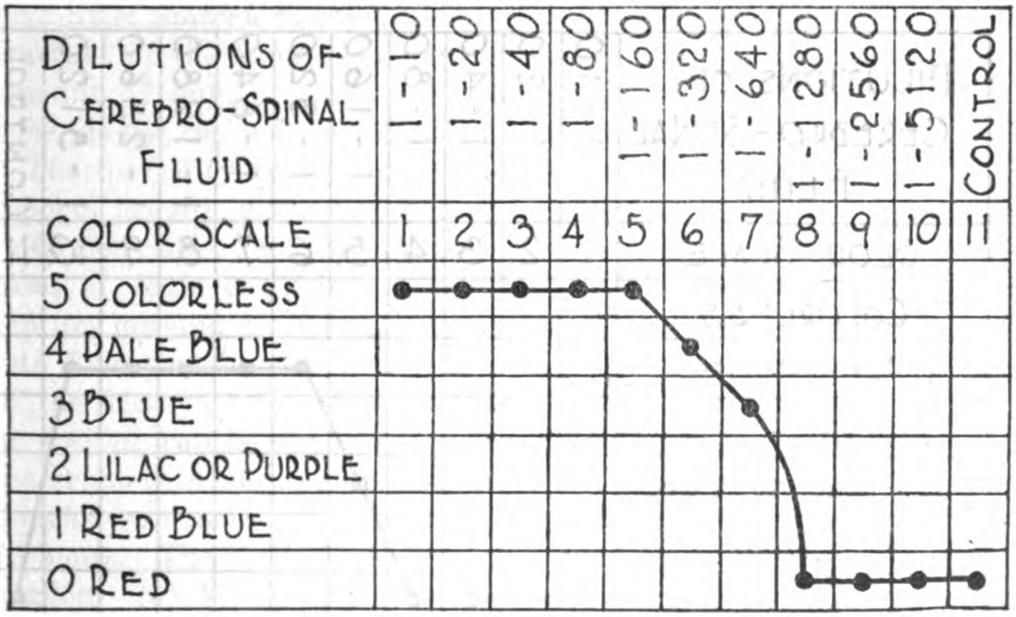

CHART 2.—Paretic zone curve

68725—25——5

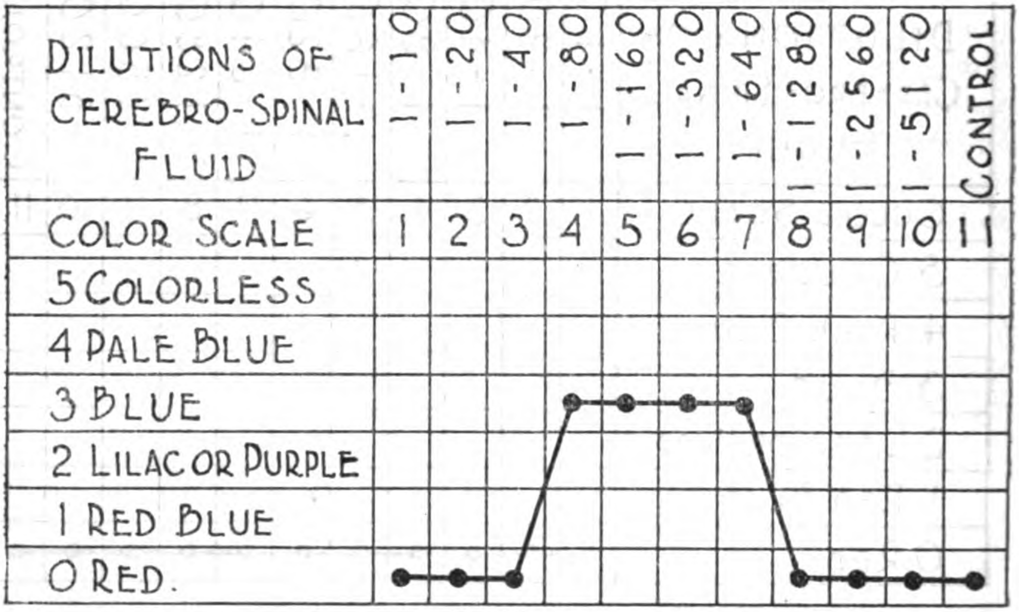

CHART 3.—Luetic zone curve

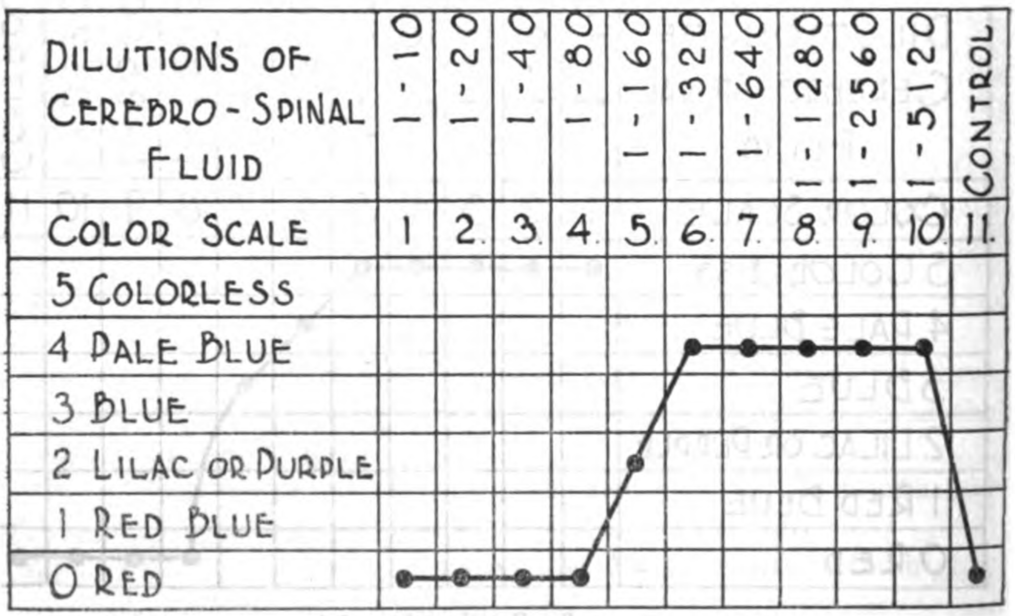

CHART 4.—Meningitic zone curve

the differentiation is difficult clinically between paresis and cerebrospinal syphilis.

2. A positive Wassermann reaction and a paretic zone curve usually run hand in hand.

3. There is no parallelism between the clinical evidence of neurosyphilis and the Lange test. The latter may be and often is positive when the former is entirely absent. (Weston, Amer. Jour. of Syphilis, April, 1919.)

4. In short, the Lange test furnishes corroborative evidence of neurosyphilis.

5. Test your colloidal gold solution on known paretic spinal fluids before using it in diagnosis.

6. The color of the solution must always be reddish; otherwise it is worthless. Repeated trials in making will usually make one proficient in its manufacture.

ACUTE INJURIES OF THE BRAIN

By G. W. Shepard, Lieutenant Commander, Medical Corps, United States Navy

During the last few years there has been a decided advance in the diagnosis and management of acute brain injuries. It was not so long ago that the problem in all head injuries was to decide as to whether or not there was a fracture of the skull; now we give little concern to the question of a fracture—except a depressed fracture of the vault—but devote our attention to determining the amount, if any, of increased intracranial pressure, for upon this depends the rationale of effective treatment.

The mortality following brain injuries is very high. The older reports usually given for "fractures of the skull" vary from 50 to 60 per cent. Jackson (1), in a more recent report of 40 personal cases of acute brain injury treated according to the present conception lowered his mortality to 25 per cent. He divides his cases into four groups: (1) Those cases of very severe crushing injuries of the head in which the patients all die within 24 hours. Little or nothing can be done to save them. (2) Cases of mild injury to the brain with unconsciousness that show a normal or only slightly increased intracranial pressure. These cases recover in from 24 to 72 hours. They are those cases that were formerly classed as concussion. (3) Moderately severe intracranial injuries, with or without a fracture of the skull. They show blood in the spinal fluid and an increase in the spinal fluid pressure of more than 12 and up to 22 millimeters of mercury. There are changes in the reflexes with possibly focal symptoms of paralysis. The coma or convulsions persist for several days. This group Jackson treats by repeated with-

drawals of from 10 to 20 cubic centimeters of spinal fluid at intervals of 12 to 24 hours, using care not to lower the pressure more than one-half at each withdrawal. (4) Severe injuries of the brain showing a spinal fluid pressure of more than 22 millimeters of mercury. These he treated by subtemporal decompression.

This is a wonderful advance, cutting the former mortality rate by more than one-half and gives a new outlook in the management of these cases. It frequently happens that the patients with extensive fractures of the skull suffer much less damage to the brain than those with no fracture, but in either case the presence of a marked increase in intracranial pressure demands prompt treatment for its reduction.

Signs and Symptoms

Some of the more important signs of acute brain injury are: 1. *Shock.* It is very rare that these patients do not suffer an initial period of shock lasting from one to several hours. There may or may not be unconsciousness. The skin is pallid, cold, and clammy and the temperature subnormal. The pulse is rapid, weak, and thready. The respiration is shallow and the rate increased. Cases of extreme injury do not survive this period of shock. As the symptoms of shock subside there follow changes in the pulse, respiration, and temperature.

2. The *temperature* is a fair guide, especially when considered with the other clinical signs, of the patient's condition. There is practically always some elevation of temperature—100° to 102°. The temperature in itself, however, is no indication as to the amount of intracranial pressure, except in the terminal stage of medullary edema when there is a sharp rise to 105° or higher and when it is too late to institute any effective treatment.

3. The *pulse*, as stated above, during the period of shock is rapid—120 or more. As the shock gradually subsides the pulse rate falls. It may go to normal and below—as low as 50. Ordinarily, the lower the pulse rate the greater the intracranial pressure; but a low pulse rate can not be waited for, as many individuals with a pulse rate as high as 70 will show a high degree of intracranial pressure; moreover, when it does appear it is a late danger signal. A rapidly mounting pulse rate following this period of normal or slow pulse is an indication of medullary edema and is practically always soon followed by collapse and death.

4. The *respiration*, like the pulse, is affected by the shock, during which time it is shallow and rapid. As the shock subsides the rate quickly returns to the normal, but, responding subsequently to a medullary edema, it rapidly rises and is very apt to assume the Cheyne-Stokes type.

5. The *blood pressure*, theoretically, rises as the intracranial pressure increases. This is the natural response of the vaso-motor mechanism to force blood into the brain against the increased pressure. Practically the blood pressure is a very untrustworthy guide, as the intracranial pressure frequently reaches a dangerous extreme before it is shown in the blood pressure.

Sharpe (2) says: "It has been a most interesting study to observe the rhythmical variations of blood pressure synchronous with the variations of temperature, pulse, and respiration rate—a lowered blood pressure (100–120) during the period of initial shock, associated with a subnormal temperature and increased pulse and respiration rates. As the shock lessens, then the blood pressure slowly ascends (130–140) with the temperature, while the pulse and respiration rate descend. If the intracranial pressure became very high, then the blood pressure continued to ascend slowly (140–160), the temperature remaining above normal (101°–103°), and the pulse and respiration rates dropped to 60 and 16, respectively, and even lower. If medullary edema should be permitted to occur, then the blood pressure descended rapidly to 100, and even lower, while the temperature rose to 105° plus, and the pulse and respiration rates to 150 and 40 plus, respectively, to be followed within several hours by the exitus of the patient."

6. *Paralyses* may or may not occur. When present, they may be caused by a depressed fracture over the motor area, an extradural or subdural hemorrhage over the same area, a direct laceration of a cranial nerve, or a general or localized edema of the motor tracts with or without brain laceration. It will be seen that paralyses in themselves, unless associated with increased intracranial pressure, as would occur in hemorrhage, edema, or a depressed fracture, are no indication for operation.

7. *Loss of consciousness* is present in the vast majority of patients having brain injuries with or without fracture of the skull. When this is prolonged it usually indicates a marked increase in intracranial pressure. This is not always the case, however, as patients suffering severe laceration of the brain tissue may not be rendered unconscious, as well as those in deep coma may not show much if any increase in intracranial pressure.

8. The *reflexes*, both superficial and deep, are usually inactive or possibly abolished during the period of shock. As the shock symptoms disappear and as the intracranial pressure increases the reflexes all become more and more active and may become quite exaggerated. An ankle clonus, with a positive Babinski sign, indicates damage or compression of the pyramidal tract. In the majority of cases of brain injury the general increase in intracranial

pressure effects both hemispheres, so that these changes in the reflexes will be bilateral; but where there is trauma of a single motor tract or a unilateral extradural hemorrhage causing pressure over one motor cortex the changed reflexes will then be unilateral or more pronounced on one side. In this case these signs will be of value in localizing the site of brain injury.

9. The *pupils*, during the shock, are usually found dilated and react sluggishly to light. As the patient recovers from the shock the pupils usually return to normal size and light reaction, unless there is increased intracranial pressure, in which case they may remain dilated and sluggish. Inequality of the pupils is due, when one of the pupils is contracted, to an irritative lesion in the cortex of the homolateral lobe. As the pressure increases from edema or hemorrhage the contraction is followed by dilatation.

The signs and symptoms of increased intracranial pressure as outlined above are all more or less indefinite and inaccurate, and many of them appear so late as to show only an extreme degree of medullary compression—so late, in fact, that a decompression then will not save the patient. The two procedures now to be described are accurate and definite means of determining early increased pressure. They are ophthalmoscopic examination of the fundi of the eyes and measurement of the cerebrospinal fluid pressure through a spinal puncture by a mercurial spinal manometer.

10. The first sign revealed by *ophthalmoscopic* examination indicating an increased intracranial pressure is a dilatation of the retinal veins. Many mild cases do not go beyond this point. As the intracranial pressure increases there will next be noticed an edematous blurring of the nasal margins of the optic disks, followed by a similar haziness of the temporal margins. This will be followed by complete obscuration of the disks, appearing first on the nasal side then on the temporal side. Sharpe (2) says: "Those patients having brain injuries with an increased intracranial pressure sufficient to produce a dilatation of the retinal veins and a blurring and haziness of the nasal margins of the optic disks can still be treated successfully by the expectant palliative treatment; but if the ophthalmoscope reveals a still greater pressure, sufficient to cause an obscuration of the nasal and even the temporal halves of the optic disks—that is, a beginning papilledema—then it is always advisable and safer to relieve the increased intracranial pressure as early as possible, whether it is due to cerebral edema or a hemorrhage the principle remains the same. In these latter cases a decompression and drainage is advisable, not only to save the life of the patient by avoiding a medullary edema but to lessen the severity and number of the post-traumatic conditions so frequently following a prolonged increase in the intracranial pressure." Repeated and frequent

ophthalmoscopic examinations should be made as often as once every hour if there are beginning changes to indicate increased intracranial pressure to determine any advance in the process.

11. We come now to the means not only of determining if there is increased intracranial pressure but of determining what that increased pressure is, *viz*, *manometer* reading through spinal puncture. Landon (3) in 1917 described a mercurial manometer for this purpose, but its use in acute brain injuries was not much heard of until Sharpe (2) published his book in 1920. The spinal puncture should be made with the patient lying on his side with the median line of the head on the same level as the site of puncture. The spinal canal having been entered by the needle, the mercurial manometer is attached and the reading taken. The normal cerebrospinal pressure is from 5 to 9 millimeters of mercury, and Sharpe says that "any increase over 12 millimeters may be considered as being above physiological limits." The measurement of the cerebrospinal pressure is of the greatest importance, and should be done in every case as soon as the symptoms of shock subside, and should be repeated as often as every 12 hours so long as there is increased pressure shown. Care should be used not to withdraw much fluid (Sharpe says not more than 5 cubic centimeters) if the pressure is very high, on account of the danger of the medulla being forced down into the foramen magnum and being directly compressed by the pressure above. There is not so much danger of this happening in traumatic cases as in increased pressure from tumor. If done with ordinary care there is no danger in the procedure. Its great advantage is in being able to get exact information early. The slow pulse, irregular respiration, high blood pressure, vomiting, and choked disks are *late* signs and symptoms of increased intracranial pressure and really indicate an advanced stage of medullary compression, and when present the chances for recovery are very small indeed regardless of what the treatment may be.

The Significance of Intracranial Pressure

Under normal conditions, the intracranial pressure depends directly upon the arterial blood pressure—the higher the blood pressure the higher the intracranial pressure. The ratio remains constant, except when marked pathological intracranial lesions are present. Following a large hemorrhage or severe diffuse trauma with little hemorrhage, the intracranial pressure may then exceed the blood pressure, at first temporarily and periodically, but, if not relieved, then permanently, resulting eventually in death.

The cerebrospinal fluid, it is believed, is secreted in the ventricles by the choroid plexuses. The fluid finds it way via the foramina of Monro, third ventricle, and aqueduct of Sylvius to the fourth

ventricle. From the fourth ventricle it escapes through the foramina of Majendie and Luschka to the large subarachnoid cisterns, and then comes to bathe the entire cortex of the brain and surfaces of the spinal cord. The circulation is completed by its absorption by the arachnoid villi which drain into the dural venous sinuses. It is believed that the secretion is such that the total amount is replaced several times each day. It will be seen that any interference with this circulation which checks the absorption will lead to increased intracranial pressure and eventually edema of the brain tissue. As the intracranial pressure continues to rise, the stomata of exit are still further compressed and thus a vicious cycle is established. Le Count and Apfelbach (4), in an analysis of 504 cases of cranial injuries that came to autopsy at the Cook County Hospital, states that the most frequent change was traumatic edema of the brain. The convolutions were found flattened, suggesting pressure of the brain against the dura and the skull, with the disappearance of the subarachnoid water bed. The cerebral vessels were empty and flattened and the cortex anemic.

Outline of Treatment

In his textbook Sharpe says: " Within the last few years a notable advance has been made in the treatment of these patients. It is not so much a question of ascertaining the presence and site of the fracture (unless it is a depressed fracture of the vault) but rather of finding out whether there is or is not an increased intracranial pressure, and, if there is, then directing the treatment toward a lowering of this abnormal pressure." During the period of shock all the approved procedures used for the relief of this condition should be instituted—external warmth, absolute quiet, rectal enemata of hot black coffee, camphor in oil hypodermically, etc. If the patient is unable to survive the shock, any operative procedure will be of no avail and will only hasten the end. If the shock symptoms subside, indicated by a slowing pulse to 100 or lower, a blood pressure rising to 120 or higher, and a temperature rising to normal or above, then a thorough neurological examination should be made. The eye grounds should be studied and the cerebrospinal pressure determined. The cases will resolve themselves into two general classes—those with only a moderate increase in intracranial pressure (up to 16 or 20 millimeters) and those with much higher pressure (from 20 to 40 millimeters and even higher). Cases of depressed fracture of the vault, determined by palpation or X ray should be operated on, regardless of what the intracranial pressure may be, relieving the depressed bone. Where no depressed fracture is present the management will be determined by the intracranial

pressure. The first group—those in which the pressure as measured by the spinal manometer does not exceed 20 millimeters of mercury—can usually be best treated by the palliative, expectant method. This is an attempt to reduce the increased intracranial pressure without operation. If the patient can be made to swallow, one-half ounce doses of saturated magnesium sulphate solution are given every two hours for the first 24 hours and the same dose continued on the second and third days every three or four hours. If he can not be made to swallow, saturated magnesium sulphate is given by rectum. An ice cap or, better, an ice helmet surrounding the entire head is applied. This in a small way tends to lessen the cerebral circulation. Spinal punctures are made at least every 12 hours and 15 to 20 cubic centimeters of fluid carefully and slowly withdrawn, checking up the pressure as it is withdrawn so as never to reduce it more than one half. Fay (5) gives hypertonic sodium chloride solution intravenously. He recommends from 50 cubic centimeters to 120 cubic centimeters of a 15 per cent solution given slowly over a period of 20 minutes. This is said to reduce intracranial pressure rapidly and markedly.

The second group—those with an intracranial pressure of 20 millimeters of mercury and higher and who show a haziness of the optic disks—demand prompt operative relief. The choice of operations is a subtemporal decompression. In cases with extremely high intracranial pressure a bilateral decompression may be required. The advantages of this operation over the osteoplastic flap operation are that it is much more easily and quickly done and is less shock producing; the operation is done over a comparatively silent area of the brain; it exposes an area most frequently the site of hemorrhage, if any is present; it provides efficient drainage for the middle fossa of the skull at its lowest level; and the overlying temporal muscle permits of a firm closure without the danger of a hernia cerebri.

The convalescence of these patients should be very protracted. They should not be permitted to resume active duties for from three to six months. All excitement must be avoided, the diet should be light, and no alcohol in any form taken. Post-traumatic symptoms most frequently seen are persistent headache, early fatigue, lapses of memory, change of personality, and epileptiform seizures. The number of cases showing these post-traumatic symptoms has been reduced since attention has been given to the early reduction of increased intracranial pressure.

Conclusions

1. Attention should be focused primarily on determining as early as possible what, if any, increased intracranial pressure exists.

2. All depressed fractures of the vault should be elevated or the depressed area removed.

3. The expectant palliative treatment, including spinal drainage, will be sufficient in all cases of only moderate increase in intracranial pressure.

4. All cases showing a marked increase of intracranial pressure, determined by ophthalmoscopic examination and readings by the spinal mercurial manometer, should receive the benefit of drainage by a subtemporal decompression.

5. There are two periods in these cases when no operation is advisable, no matter how seriously the patient is injured nor how high the intracranial pressure may be. These periods are: First, the initial stage of shock, and, second, the stage of medullary edema.

REFERENCES

1. Jackson, H.: Surg. Gyn. & Obstet., April, 1922.
2. Sharpe, Wm.: The Diagnosis and Treatment of Brain Injuries. Lippincott, Philadelphia, 1920.
3. Landon, L. H.: The Absolute Determination of Intracranial Pressure, J. A. M. A., 68; 21, p. 1540, 1917.
4. LeCount, E. R., and Apfelbach, C. W.: Pathologic Anatomy of Traumatic Fractures of Cranial Bones, J. A. M. A., 74; 8, p. 501, 1920.
5. Fay, Temple: The Administration of Hypertonic Salt Solution for the Relief of Intracranial Pressure, J. A. M. A., 80; 20, p. 1445, 1923.

A CHART FOR DETERMINATION OF THE ERYTHEMA DOSE IN X-RAY THERAPY

By E. L. Whitehead, Lieutenant, Medical Corps, United States Navy

When the subject of X-ray therapy is considered by the majority of the members of the medical profession the idea is often associated with the fear of production of an "X-ray burn." This, however, is a relic of the old days of rœntgenotherapy, when the use of gas tubes and static machines or coils made the estimation of an individual X-ray dose a matter of guesswork. It is true the pioneers in this could rarely tell the actual output of radiation from their tubes from one minute till the next and the duplication of a certain dose was largely a matter of chance. Thus overdosage and subsequent reactions were not infrequent and the X ray gained a reputation for uncertainty and danger which even now, though undeserved, it has failed to live down entirely.

With the advent of the Coolidge tube in 1914 the field of therapy was revolutionized. Absolute uniformity of radiation output corresponding to energy output could be expected; the operator knew

that a certain length of exposure at a certain setting of his machine would give a skin reaction and that anything less than that amount of radiation would not; also that the same results would follow using the same factors on any other standard machine and tube.

At present in this country therapeutic X radiation is referred to in terms of an "erythema dose," which is, broadly speaking, the amount necessary to cause a noticeable but not marked redness of the human skin. Unfortunately, this is far from being an exact standard, as the precise depth of erythema constituting a skin dose is a matter of personal opinion with the radiologist and may vary considerably from a faint pink flush to an angry red. The reaction differs also according to age, sex, race, or individual pigmentation of skin, and also varies on different parts of the same person's body. There is also the rare and much discussed question of personal idiosyncrasy to the ray to be considered. However, keeping these relatively minor differences in mind, the erythema, 100 per cent, or skin unit dose, is the most satisfactory physiological standard that has yet been offered for characterizing therapeutic radiation and is the one now in general use. It corresponds to the old Sabouraud Tint B, 5 Holznecht, or Kienback 10 X. It appears within 10 to 14 days after exposure, is accompanied by complete but temporary loss of hair from the part exposed, and disappears in about three weeks, leaving some tanning but an otherwise normal skin. It is also known as a first degree radiodermatitis. It is the upper limit at which therapeutic radiation may be given without harmful after-results and should be considered a danger signal, beyond which no further exposure is permissible. Its production is only justified in grave or malignant conditions, and in practically all therapy the amount of radiation is kept below this limit. Rarely is the administration of a full erythema dose indicated.

The effect of cumulative dosage must also be considered. Roughly, an application loses one-half of its effect every three and one-half days, so at the end of a week following a 100 per cent dose only a 75 per cent dose is needed to give a reaction. In describing a therapeutic application of X rays the following factors must be given:

1. Voltage (high tension).
2. Milliamperage.
3. Time.
4. Distance (from target to skin).
5. Filter (thickness and material).

If any of these factors is not specified no idea of the amount of reaction can be formed. Thus, to speak of a dose of 20 milliampere-minutes at 100,000 volts is highly indefinite. An exposure for 15

minutes at 15 inches distance with 5 milliamperes at 130,000 volts would produce a severe dermatitis if 1 millimeter of aluminum were used as filter, but would be a very light dose if 6 millimeters were used.

It is most convenient to give treatments with certain of these factors constant, varying the dose by changing only one, usually the time factor. Thus, for superficial therapy, a voltage of around 110,000 by sphere gap measurement, corresponding to about a 7 to 8 inch point spark gap, 5 milliamperes of current, 10 or 15 inches distance, and 1 millimeter of aluminum filter are usually employed, varying the time according to the fraction of an erythema dose it is desired to give. Deep therapy with the usual Navy equipment is conveniently done with 140,000 volts, 5 milliamperes current, 20 inches distance, and 5 millimeters of aluminum filter, with like variation of the time factor. With the Coolidge tube, as before stated, an erythema dose can be delivered using the same factors, regardless of make or location of machine. The following chart is in use at the naval hospital, League Island, Pa., for instant calculation of time required to produce an erythema dose for the various distances, filters, and voltages in common use, with current constant at 5 milliamperes.

Time in minutes at 5 milliamperes current for erythema dose

Filter used (aluminum)		No filter	1-millimeter filter	4-millimeter filter	5-millimeter filter	9-millimeter filter
Kilovoltage (sphere gap)		120 K. V.	130 K. V.	140 K. V.	140 K. V.	145 K. V.
Distance						
Inches	Centimeters					
8	20	1.3	2.6	5.4	6.4	15
9	23	1.6	3.2	6.8	8	18
10	25	2	4	8.5	10	23
11	28	2.4	4.8	10.2	12	28
12	30.5	2.9	5.8	12.2	14.4	33
13	33	3.4	6.8	14.4	17	39
14	35.5	3.9	7.8	16.6	19.6	45
15	38	4.5	9	18	22.5	52
16	40.5	5.1	10.2	21.7	25.6	59
17	43	5.8	11.6	24.5	28.9	66
18	45.5	6.5	13	27.5	32.4	74
19	48	7.2	14.8	30.6	36	83
20	51	8	16	34	40	90

It must be remembered that the figures stated here are for a full skin dose, and are practically never used as such, but a fraction is given according to the indications of the lesion. The figures indicate the upper limit of safe radiation; they are in the danger zone.

Also the safety factor in the unfiltered and 1 millimeter columns is very low; that is, a difference of a minute in a dose will make a great difference in the amount of reaction, while an error of several minutes in the dose of highly filtered rays would be of comparatively minor account. The figures stated have been determined by experimental exposures at 10 inches distance for the varying thicknesses of filters, and by mathematical calculations from those results, using the inverse square law for the other distances. With the presence of such definite and easily established factors, it can be seen that the production of an unfavorable reaction can almost always be traced to some technical error of the operator and not to any freak or uncertainty of the X rays themselves. The commonest source of accident, which has frequently occurred to the best of civilian specialists, is the omission of the proper filter. The filter should always be checked by at least two people before any treatment is started. The actual giving of X-ray treatments may be left in the hands of a properly trained corpsman. Practically all therapy in civilian life is done by nonmedical technicians. However, the prescription of the various factors of the dose, the protection of the patient from overexposure or electrical dangers, the selection of the proper fields, and the number and frequency of the treatments must be under the closest supervision of a trained physician.

The chart is not applicable to the "deep therapy" outfits where the voltage used is around 200,000 and where the output is more or less dependent on the wave form and other characteristics of individual makes of machines. Nor does it take into account "cross-firing" or repetition of exposures. It is confined to the effect on the skin alone and does not take into account the reactions that may take place in deeper organs, as intestines or ductless glands, which might be seriously affected by cross-fire without injury to the skin appearing. However, it gives the medical officer doing X-ray work who has not been specially trained in therapy a safe guide to follow in all superficial and skin work. By gaining an idea of the approximate erythema dose of his machine and referring to McKee's invaluable book, X Rays and Radium in Treatment of Diseases of the Skin, for details, it is possible for the medical officer to give his cases the benefit of X ray, especially in those very common skin diseases, chronic eczema, acne, and psoriasis, which are so greatly helped by that agency.

With the safeguards of modern appliances and modern technique in operation by the radiologist, no medical officer should ever be deterred by out-of-date and superstitious fears of possible "X-ray burns" from giving a patient the benefits of radiotherapy in the many pathological conditions for which it is indicated.

AN ANALYSIS OF AVIATION CRASHES[1]

By J. D. Benjamin, Lieutenant, Medical Corps, United States Navy

It has been a known fact since statistics in aviation have been compiled that the greatest cause of all crashes in flying is the pilot. Figures definitely prove this fact. Improve the pilots and the number of crashes are cut down.

An analysis has been made of the crashes occurring on this station during the past two years and six months. Seventy-nine crashes occurred during this time. One hundred and thirty-four people were in the planes that crashed, either in the capacity of pilot, student, or passenger. Of this 134 who were on these flights, 5 were killed, 5 were drowned, 11 were seriously injured but recovered, and 26 suffered minor injuries, such as lacerations and contusions, which allowed them to return to duty the same day or in a few days. This makes a total of 47 who were killed, drowned, seriously injured, or suffered minor injuries. Therefore, 35 per cent of those in planes crashing suffered from some form of injury. Two of those included above who suffered from serious injuries have since given up aviation, saying that they "did not feel right up in the air." A third has since been killed in a crash away from this station.

It is interesting to note the nature of the injuries received. Not including those drowned or killed outright, among the injuries it is found that fractures are the most common, 6 being included in the list. These are divided into fractures of the jaw, 3; fracture of ribs, 1; fracture of leg, 1; fracture of forearm, 1. Multiple injuries serious enough to put the aviator in the hospital come next, 5 being recorded. Two cases of concussion also occurred. The other injuries were of such minor nature as to allow the injured man to return to duty the same day or in a few days.

The cause of any crash should come under one of four headings: (1) Fault of the pilot; (2) mechanical; (3) unavoidable; (4) unknown. (1) Under *fault of the pilot* are included such reasons as poor judgment, inexperience, landing with the wind, distraction, turning into field with dead motor, faulty piloting, and other causes definitely due to the pilot. (2) Under *mechanical causes* are included motor failure, faulty construction of plane, propeller or other part of the plane carried away, ignition failure. (3) *Unavoidable causes* include collisions in the air due to another plane, landing quickly to avoid collision, fog, and weather conditions. (4) Under the heading *unknown* are cases to which a cause can not be assigned, for instance, trying out a new type of plane and getting into a spin from which it is impossible to come out.

[1] From United States Naval Air Station, Pensacola, Fla.

The pilot, as has been said before, is the cause of the majority of crashes. Out of 79 crashes 55 were definitely shown by boards of investigation to be due directly to the pilot, one or another of the causes mentioned in the preceding paragraph under heading (1) being given. Therefore, the pilot in this series was responsible for 69 per cent of the crashes. Of the other 24 crashes the following causes were found: Fire, 2; motor failure, 3; unknown, 2; propeller carried away, 1; forced landing in poor field, 4; unavoidable, 1; collisions with another plane not the fault of the first-named pilot, 2; student froze controls, causing instructor to crash, 1; fog, 1; mechanical, 2; pontoon spread open, 1; pilot made bad landing to avoid collision in air, 1; ignition failure, 1; student put plane into spin at too low altitude for instructor to get it out, 1; faulty construction of aircraft, 1. Of the 24 not directly assigned to the pilot it is believed that closer investigation would show that a large percentage of the crashes were due to the pilot, either directly or indirectly.

During the preceding six months—that is from July 1, 1922, to December 31, 1922—11 crashes occurred, with 6 people being killed or injured. Of these 6 who were casualties, 2 were killed, 1 was seriously injured but recovered, and 3 suffered minor injuries and soon returned to duty. The rest of the pilots and passengers escaped without injury. During that time 1 crash occurred in July, none in August, 5 in September, 4 in October, none in November, and 1 in December. From this, July, August, November, and December would seem to be the safest months in which to fly and September and October the most dangerous.

During the entire three-year period from July 1, 1922, to June 30, 1925, 59,265 flights were made to a total of 52,584 flying hours. Considering the total number of crashes (90) for the period, it is seen that the percentage of crashes to number of flights is 0.16 per cent. Therefore, a student or pilot in this series of flights crashed once in every 658 flights. A total number of 52,584 flying hours covered 59,265 flights, so that each flight may be assumed to have been of one hour duration. Considering 90 crashes occurring during this time, it would show 0.19 per cent of crashes per hour of flying. Therefore, a student or pilot crashes once in every 584 hours of flying. As a student in training usually flies about 200 hours, it can be seen that the chances of his crashing during this course of instruction are about 1 to 3. As a matter of fact they are much less than that, probably about 1 to 7 or 8, as students alone were not considered in this series, but both pilots and students were taken together.

This is shown better in the analysis of crashes from July 1, 1923, to June 30, 1925, where the students and pilots have been taken up

separately. Here, out of 79 crashes 54 were due to qualified pilots and 25 to student flyers. Therefore, 69 per cent were due to pilots and 31 per cent to students. These figures must be taken with a grain of salt, however, as, in many cases where the pilot was held responsible for the crash, it was actually the student's fault, the pilot or instructor being blamed as he was actually in charge of the plane during the period of instruction, although not in reality flying it.

Considering the question of the mortality from flying, 7 were killed and 5 were drowned, making a total of 12 deaths due to aviation during this period of three years. As 59,265 flights were made, one death occurred out of each 4,938 flights, or a mortality of 0.0002 per cent per flight. As to flying hours, considering the total hours of 52,584 as given, it would show one death in each 4,382 hours of flying. This was all the hardest kind of flying, for it was flying by beginners who were under a course of instruction.

Considering all the crashes that have taken place on this station in the three-year period from July 1, 1922, to June 30, 1925, it is noted that 13 crashes occurred in August and the same number in September. October came next with 11 crashes, and June, July, and March show 10 crashes each. Seven crashes took place in April and seven in May, while February shows six and January five. In December two occurred, but none in November. From this series, August and September would seem to be the most dangerous months in which to fly and November the safest. A number of factors must be considered here. For instance, the months when formation flying has taken place have seemed the worst. Also any month when there are a greater number of flights, according to the law of averages, should be the most dangerous, as we have shown that one crash occurs in each 630 flights. Therefore, if more flights take place, there is the probability of more crashes taking place. Another thing, students who have just received their designation are apt to "feel their oats" and do stunt flying beyond their own capacity or that of the plane, as they think they are good. Overconfidence is apt to breed carelessness and recklessness. Another factor at this stage of the game that predisposes to crashes is the attempt, when the course has been delayed, to rush students through at its end, giving them many hours' flying in one stretch in one day. They become tired, stale, nervous, apprehensive, and are in poor shape to fly. A new arrangement of giving them flights of shorter duration has to a great extent eliminated this trouble.

It has been said that the physical and psychological examinations for flying are too strict. That they are not too strict is proved by the following figures of the number who start training, having passed their aviation physical and psychological examination. Dur-

ing the fiscal year 1923, 111 started training and 66 finished. For 1924, 95 students started training and 68 completed the course. During the fiscal year 1925, 176 started training and 87 received designation. In other words, during a three-year period 57 per cent of those students who were found physically and psychologically qualified to enter aviation training actually qualified. Therefore, it can be seen that, if some of the students who failed to learn to fly had been psychologically disqualified or not allowed to fly with a waiver for physical disability, a great saving in time and money would have been effected. Hence, even stricter physical and psychological examinations would not be amiss. A poor student in aviation who barely qualifies and leaves the station with a designation is a menace to himself as well as to his squadron. He is a potential "crash" and when he does crash he usually cracks up a valuable plane and injures himself and others as well. A student qualified with a physical disability waived, although apparently a good flyer, is a potential "crash" just as is the poor flyer. It would seem best, then, to qualify fewer and better flyers rather than a great number of mediocre pilots. The belief that a poor pilot will improve after he leaves the school and joins a squadron is justified in a few cases but in the vast majority is not, as the record of such pilots will show. They are frequently in a number of crashes, most of which they explain or whitewash as due to some fault other than their own.

To summarize, in three years of flying at the United States Naval Air Station, Pensacola, Fla., there were 90 crashes out of 59,265 flights to a total of 52,584 flying hours. One crash occurred in each 584 hours of flying, or one crash out of every 658 flights. Twelve deaths occurred; one out of every 4,938 flights, or one out of every 4,382 hours of flying. August and September seem to be the most dangerous months for flying and November and December the safest. The pilot continues to be the most dangerous factor in flying. Therefore if one is going to take an aviation trip it is well to pick one's pilot.

CLINICAL NOTES

BUNDLE-BRANCH HEART-BLOCK—REPORT OF CASE[1]

By H. B. Hill, Lieutenant (Junior Grade), Medical Corps, United States Navy

Heart-block is well defined as an abnormal heart mechanism, in which there is a delay in, or absence of, ventricular response to the auricular impulse.

It is to be recalled that the recognized types of these allorhythmias include (1) auriculo-ventricular block, (2) sino-auricular block, and (3) interventricular or bundle-branch block. It is the aim of this article to discuss the latter type, with particular reference to the diagnosis.

Probably the earliest case of interventricular heart-block to be described was that by V. Leyden in 1868, who reported a case of bigeminal pulse in which he assumed that one ventricle was contracting without the other. However it was not until the advent of the electrocardiograph that these conditions could be readily recognized.

In 1893 William His, jr., described the presence in the mouse, dog, and man of a bundle of muscle fibers which "arises from the posterior wall of the right auricle near the interauricular septum, in the atrio-ventricular groove, lies upon the upper edge of the muscular interventricular septum, passes forward and to the vicinity of the aorta, where it divides into a right and left branch. The latter passes down to the base of the anterior mitral cusp." Tawara later found that the muscle bundle of His is in reality continuous with the network system of Purkinje fibers which permeates both ventricles. He also demonstrated the presence of nerve fibers within the His bundle. Gordon Wilson has recently demonstrated ganglion cells as well.

In the normal heart the impulse of contraction starts at the sino-auricular node, a mass of specialized muscular tissue at the superior cavo-auricular junction, spreads through the bundle of His and is distributed thence through the Purkinje fibers to the ventricles and their papillary muscles. If the transmission of this impulse is interfered with by disease in the bundle of His, there results a condition of block, varying in severity according to the degree of interference. And if this obstruction takes place in one of the branches of the His bundle there occurs what is known as bundle-branch or interventricular heart-block.

[1] From United States Naval Hospital, Washington, D. C.

In the majority of cases of heart-block examined post-mortem damage of the auriculo-ventricular bundle at or beyond the auriculo-ventricular node has been found, due to acute inflammatory changes or to sclerotic changes or to the presence of gummata. There has been an absence of any demonstrable lesion in a number of cases. Hirschfelder reports the following lesions demonstrated in a series of cases:

1. Gumma.
2. Calcified patches involving the bundle.
3. Fibrosis of the bundle.
4. Fibroma of the septum.
5. Anemic infarction of the atrio-ventricular bundle.
6. Simple round cell infiltration of the atrio-ventricular bundle.
7. Mural ulceration involving the atrio-ventricular bundle.
8. Fatty degeneration of the atrio-ventricular bundle.
9. Arteriocleroses of the artery supply of the atrio-ventricular bundle.

Heart-block is more common in males than in females. Most cases fall into two groups—(1) Patients, usually young adults, who have previously suffered from a rheumatic infection of the heart, and (2) patients, usually elderly people, who are suffering from myocardial degeneration. In the latter type there is a history of syphilis in a large proportion of cases. The milder grades of block may be found in patients suffering from infective diseases, such as acute rheumatism, influenza, diphtheria, and pneumonia. The condition is usually temporary, however, in these conditions.

There are no physical findings which can be relied upon to furnish conclusive evidence of the presence of this lesion. MacKenzie states that in one case he noted a reduplication of the first round. The electrocardiograph is essential in establishing the diagnosis. As regards the findings in the electrocardiographic tracings, Pardee considers the following departures from the accepted normal as essential:

(1) The ventricular complex has an abnormally wide Q. R. S. group, the duration being for the human heart at least 0.14 second, and usually more than this. Remembering that the upper limit of this interval is considered to be 0.1 second, this indicates that the contraction is requiring an abnormally long time to involve the whole of the ventricular mass. This is due to the fact that it must now spread from one ventricle to the other through the ventricular muscle, instead of being distributed to both ventricles almost simultaneously by the right and left branches of the bundle of His and their ramifications. During the normal ventricular contraction the

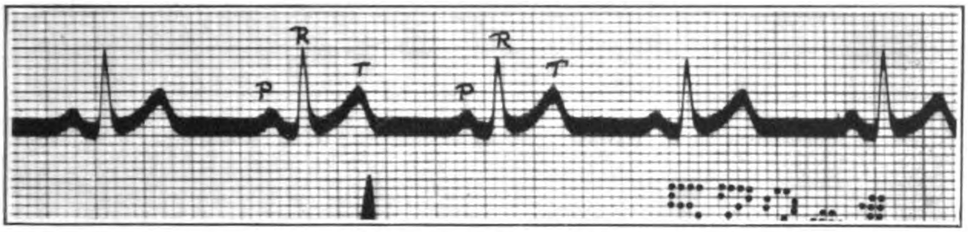

FIG. 1.—NORMAL ELECTROCARDIOGRAM FOR COMPARISON WITH FIGURE 2

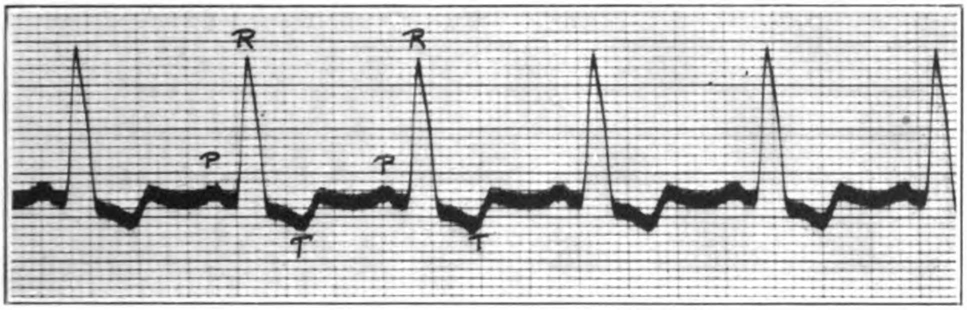

FIG. 2.—LEAD 1. THERE IS AN ABNORMAL Q. R. S. GROUP, THE DURATION BEING 0.12 SECOND. THE Q. R. S. WAVE IS OPPOSITELY DIRECTED TO THAT IN LEAD 3. THE DESCENDING PORTION OF THE GROUP HAS MARKED SLURRING. THE T WAVE IS OPPOSITELY DIRECTED TO THE Q. R. S. WAVE

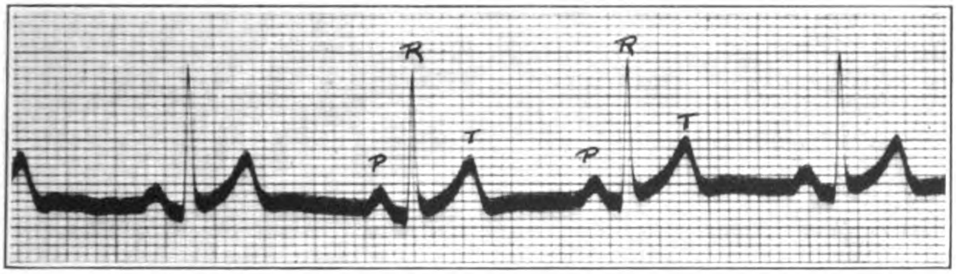

FIG. 3.—NORMAL ELECTROCARDIOGRAM FOR COMPARISON WITH FIGURE 4

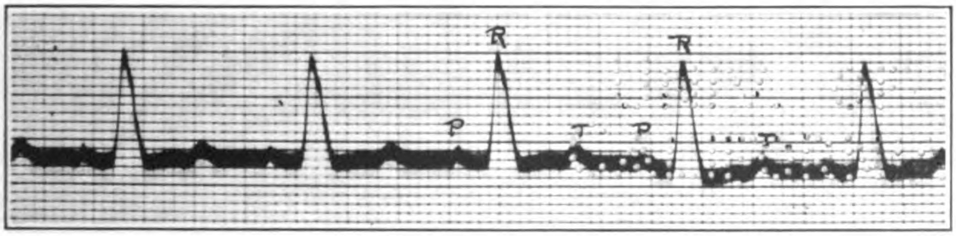

FIG. 4.—LEAD 2. NOTE THE WIDE Q. R. S. WAVE AND SLURRING OF THE DESCENDING PORTION, ALMOST TO THE POINT OF NOTCHING. THE RHYTHM IS REGULAR AND THE RATE 80 PER MINUTE

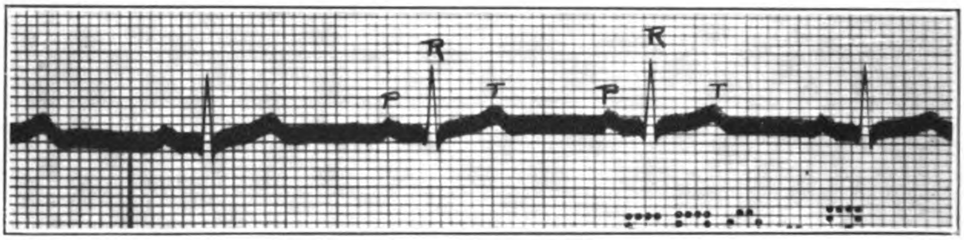

FIG. 5.—NORMAL ELECTROCARDIOGRAM FOR COMPARISON WITH FIGURE 6

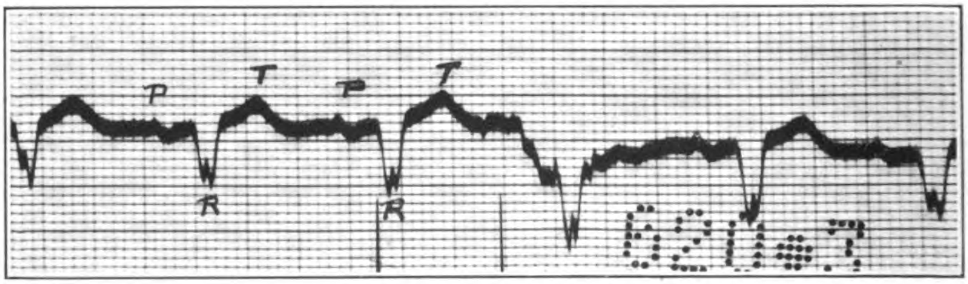

FIG. 6.—LEAD 3. THE Q. R. S. WAVE IS WIDE, NOTCHED, AND INVERTED. THE T WAVE IS OPPOSITELY DIRECTED TO THE Q. R. S. WAVE

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distribution of the impulse to the whole of the inner surface of both ventricles is probably completed in 0.02 to 0.03 second. The remainder of the 0.08 to 0.10 second needed for the complete spreading of the contraction is occupied in its passage through the thickness of the ventricular wall. It is plain from this, then, why the spreading of the contraction through the septum would greatly prolong Q. R. S. in this condition.

(2) The largest wave of Q. R. S. is oppositely directed in leads 1 and 3, either upright and downward, or the reverse of this. By noting the direction of the chief deflections of Q. R. S. in the three leads it can be determined which ventricle contracts first. From this it is deduced that the bundle-branch to the opposite ventricle is affected. Hence, if the chief deflection of Q. R. S. is downward in lead 1 and upward in lead 3, then the right ventricle precedes and the lesion is of the left bundle-branch. On the other hand, if the chief deflection is upward in lead 1 and downward in lead 3, then the left ventricle precedes, and the lesion is in the right bundle-branch.

(3) The Q. R. S. group always shows notching or thickening of the ascending or descending portion in more than one of the leads, or there may be a notching of one of the peaks. These notches or slurrings are due to a disturbance in the production of the electrical potential within the heart. This abnormal production of potential is the result of an interference with the normal spreading of the contraction wave by lesions affecting a large area of the Purkinje ramifications, or by the presence of a large focus of diseased muscle in the ventricular wall.

(4) The T wave is opposite in direction to the largest Q. R. S. in all three leads, but exceptions to this rule occur when the Q. R. S. group in one lead has a small relative value, or has both upward and downward waves. The abnormal inversion of T results from one of two causes—either the change in the time relations of the right and left ventricular contractions resulting from a large lesion of the Purkinje system or the muscular unbalance of the two ventricles during the contraction when the notching is due to a large area of ventricular disease.

(5) The size of the largest deflection of Q. R. S. in its largest field is usually well above the average normal figure of 12 millimeters.

(6) The height of the T wave in its largest lead is usually greater than the maximum (5 millimeters) which is normal for T. A large T will result from disease affecting the bundle-branches or Purkinje system so as to cause notching of the Q. R. S. group, and also from

a strong ventricular activity, which of course demands a good condition of the muscle fibers.

(7) If the P wave is present it is followed by the abnormal ventricular complex after a P. R. interval, which is constant from beat to beat and is usually normal; or, if auricular fibrillation should be present, these abnormal complexes will occur with the irregularities characteristic of this condition.

CASE REPORT

W. J. L. Admitted November 17, 1924.

Complaint.—General weakness and lassitude. "Rumbling in abdomen."

Present illness.—Onset noted five days ago with marked nausea and considerable vomiting, following a meal containing much fat and lemonade. Vomitus was very sour. No diarrhea. Free catharsis obtained by use of salts. After another meal there was a sensation of fullness in the head and there occurred frequent watery stools. Recently there has been considerable rumbling in abdomen. Slight edema of ankles present in the mornings.

Past history.—Rubeola, pertussis, varicella, and scarlet fever during childhood. No known complications. "Inflammation of lungs" at age of 4. No other illnesses. No cough, expectoration, hemoptysis, dyspnoea, night sweats, palpitation, retrosternal or precordial oppression or pains. Appetite good. Bowels generally regular. Ordinarily no nausea or vomiting. No belching, hemorrhoids, or flatulence.

Denies venereal infections. No hematuria, polyuria, nycturia, or dysuria.

No headache, dizziness, insomnia, fainting spells, nervousness, epilepsy, twitching, tremors, spasms, cramps, weakness, paralysis, abnormal sensory disturbances, neuralgias, wasting, rigidity, aphonia, aphasia, tinnitis, defects in special senses and organs of special senses.

No fractures, arthritis, swellings, deformities, or limitation of motion.

Habits.—Drinks and chews moderately. Does not smoke. Is a heavy, rapid eater.

Physical examination.—Patient is a hypersthenic, well-nourished individual, weighing 155 pounds and being 67½ inches in heighth. T. P. R. normal. Skin is moist and clear.

Eyes, negative. Reactions, normal. Ears, negative. No loss of hearing or discharge. Nose, negative. No epistaxis.

Mouth.—Lips have normal color. Few carious teeth and crowns. Moderate degree of pyorrhea. Tongue is slightly coated and protrudes in midline without tremor. Tonsils are somewhat hypertrophied but apparently not diseased.

Neck.—Grossly negative. No abnormal pulsations, rigidity, retraction, or swelling. Thyroid not palpable. No tracheal tug elicited.

Lymph glands.—Anterior cervicals palpable but not tender.

Chest.—Well developed and symmetrical. Expansion equal and good. No masses noted. On percussion the aortic area is definitely widened. There is impairment at both bases posteriorly. Mucous râles elicited on inspiration in both bases behind.

Heart.—Apex impulse is neither seen nor felt. Is percussed in fifth interspace about 9½ centimeters to the left of midline. No abnormal pulsations or

precordial fullness noted. No shock, thrill, friction rub, or precordial tenderness noted.

On percussion the cardiac dullness is located as follows:

Interspace	Right	Left
	Inches	*Inches*
Second	1¾	1⅝
Third	2⅜	2⅜
Fourth	2¾	3½
Fifth	3¾	4½
Sixth	3¾	4½

On auscultation the sounds are very poorly heard, on the left being distinctly muffled at the apex. P2 is scarcely heard. A2 is loud and snapping, and there is a long, rough, systolic murmur in the aortic area. Occasional extra systoles followed by a compensatory pause noted.

Pulse.—Is well sustained, synchronous, and full. Rate 80 per minute. Extra systoles followed by compensatory pause occurring from five to ten times per minute noted. B. P., systolic; at 170 millimeters of pressure, 10 loud beats come through per minute, while at 160-millimeter pressure all come through. But in the latter instance 5 are very loud. Diastolic, 90.

Abdomen.—Grossly negative. No masses, spasm, or tenderness noted. Liver, spleen, and kidneys not palpable. No hernia.

Rectal.—Few external hemorrhoids. No fissures.

Gentalia.—Left testicle is large and nodular but painless.

Extremities.—No tremor, edema, or varicosities.

Reflexes.—Knee jerks hypoactive. Rhomberg and Babinski negative. No clonus.

Laboratory:

R. B. C., 5,140,000.
W. B. C., 12,000.
Hemoglobin, 95 per cent, Tallquist.
Poly., 82 per cent.
Lymph., 12 per cent.
L. M. and T., 5 per cent.
Eosin., 1 per cent.
Noguchi and Kolmer, negative.

Urine.—Light amber, acid, specific gravity, 1,060; albumen and sugar, negative; few epithelial cells.

Sputum.—Negative for tubercle bacilli.

Feces.—Negative for ova and parasites.

Electrocardiograph:

Rate, 82.
Rhythm, regular.
P–R interval, 0.15 second.
P waves of low amplitude throughout and diphasic in lead 3.
Q. R. S. broad (0.12 sec.) and slurring of S is constant.
T 1 inverted, and T 2 and 3 upright. (See Figs. 1 to 6.)
Conclusion:

Left axis deviation (index, plus 22).
Right-bundle-branch block.

Resistances:

Lead 1, 900 ohms.
Lead 2, 1,000 ohms.
Lead 3, 500 ohms.
String, 500 ohms.

Fluoroscopic examination.—The heart appears enlarged to the right with a dilated aorta. The right border of the heart and the aorta form almost a vertical line. The heart enlargement does not extend through to spine, a clear shadow being seen between the spine and heart. No saccular aneurysm made out.

X ray.—The shadow of the heart and great vessels appears to be increased in width, especially on the right side. This right-side preponderance may be due to some extent to displacement in the lateral or oblique position. The posterior mediastinum does not appear to be impinged upon by the heart shadow. There is definite pulsation at the right border of the great vessels. The spine shows a scoliosis in the upper thoracic vertebræ with its convexity toward the left.

Conclusion: Aneurysm of the ascending aorta (?). Fluid or new growth in the upper mediastinum (?).

The patient's symptoms subsided in a few days under rest, diet, and eliminatory therapy. A diagnosis of aneurysm of the ascending aorta and right-bundle branch-block was made. Patient was discharged December 8, 1924, in good condition.

EAR AFFECTIONS RESULTING FROM NEPTUNE'S PARTY

By W. S. SARGENT, Lieutenant (Junior Grade), Medical Corps, United States Navy

The holding of a "Neptune's party" on crossing the Equator is an old and well-established custom. Every one likes to see the program carried out. That accidents occur is well known, and certain restrictions have gradually been placed upon the stunts. This paper is not written to suggest reformation of old customs, but, judging from the number of ear affections seen and treated which resulted from this day's program on one ship, it would eliminate much pathology and suffering if the "water part" of the program were done away with. About 30 cases of ear diseases could be traced to this day of entertainment. There were cases of otitis externa, diffusa and circumscipta, myringitis, aggravation of the condition of cerumen inspissatum, rupture of membrana tympani, otitis media catarrhalis acuta, and mastoiditis acuta. It has been learned that other ships also had a number of such cases.

The usual tank was rigged on the quarter-deck. The victim was slid down a board so that he lit in the tank both backward and head first. Those in the tank kept him well submerged and, as he came up gagging, coughing, strangling or vomiting, he was ducked under, over and over again. This is mentioned to show how the

nasal and pharyngeal secretions were undoubtedly washed into the Eustachian tube. How much part the hits on the head played in injuring the membrana tympani can not be said. As the man left the tank a very forceful stream of water from a large hose was turned on him, being directed toward his head as a rule. This could readily cause external ear affections and injuries to the drum, and undoubtedly did so. The cases were seen anywhere from one day to a week after the party. There was probably a considerable number of light cases who did not report to the sick bay. During the six months prior to this occasion there were not so many cases as developed during the week following it. Whether or not these men already had some nose and throat trouble, the water episode furnished the immediate and exciting cause of infection. One thousand three hundred men were put through the tanks and although the water was changed, pollution was evidently considerable.

It is rare for a case of external inflammation to cause perforation of the drum and subsequent middle-ear disease, yet this may occur.

Practically all patients came to the sick bay complaining of pain in the ear. Even the men who had had the wax washed against the drum had pain from the pressure on the membrane. Reduced hearing and tenderness were common symptoms. In many patients autophony and tinnitus were present. Fever was not a common symptom. Pain and tenderness may be present in the parotid region due to extension of the process through the fissures of Santorini. Since so many of the same symptoms may occur in the different affections of the ear, it is upon the physical signs that we have mostly to rely in order to make a diagnosis. It may not be amiss, therefore, to describe the appearance of the normal external auditory canal and the membrana tympani.

There may be a number of long hairs which obstruct the view unless pushed aside by rotating the speculum. The cartilaginous portion of the external auditory canal is not in line with the osseous portion, but can be made so by pulling the auricle upward, outward, and backward. The osseous part is of a delicate pink color; it is smooth and glistening. The membrana tympani, normally, by daylight reflection, is of a pearly gray color having a bluish tint. By gaslight it appears of a yellowish color, tinged slightly red. The long handle of the malleus is very plainly seen in its full length; if shortened, the drum is probably retracted. The umbo is normally somewhat depressed, and the cone of light runs from the umbo downward and forward. Its apex is at the umbo. The short process of the malleus is above and the anterior and posterior pillars, or folds, run from it to the periphery. Between these folds is Shrapnell's

membrane. The tympanic membrane is placed obliquely to the long axis of the bony canal, so that the superior and posterior walls are not so long as the inferior and anterior. There is a certain amount of retraction at the umbo, and, while the drum is concave as a whole, it is convex from the center to the periphery.

Differential Diagnostic Points

Acute diffuse otitis externa is often very painful. It hurts to move the jaw or press on the tragus. The parotid region may be involved via the fissures of Santorini. Pulling on the ear to straighten the canal causes pain and, often, the pressure of the speculum is excruciatingly painful. There may be fever with tinnitus and perhaps vertigo. Itching is often complained of. If the swelling is enough to close the canal there will be more or less deafness. In most cases the meatus becomes very swollen and narrow. It is greatly congested. Even the drum may be red and injected and, if the landmarks are obliterated, otitis media may be thought to be present also. Where the ear canal is open enough to allow a good view of the drum the hearing will not be altered in otitis externa as it is in otitis media. In uncomplicated otitis media no pain is caused by using the speculum properly. The dermal layer of the skin of the canal often peels off in otitis externa. A chronic purulent otitis media may show granulations on the drums and resemble otitis externa.

Otitis externa circumscripta acuta shows symptoms similar to the diffuse form, but inspection with the speculum shows a localized or circumscribed swollen, tender, painful, red, and edematous area. If on the posterior wall, there may be swelling and redness which simulates mastoid disease, but a careful examination shows this to be a furuncle in the meatus, and there is no evidence of middle-ear disease and no impaired hearing if the meatus is not blocked by the swelling. If on the anterior wall, the parotid may appear to be affected, but an examination of the meatus reveals the real cause. A polypus may resemble a boil, but has no acute inflammatory symptoms, and there is usually a history of previous middle-ear disease. An exostosis is differentiated from a furuncle by touching it with a probe when the exostosis is found hard and bony and not so sensitive. Simple swelling of the meatus is not inflammatory and can be told from a boil.

Myringitis symptoms are milder than those of otitis media. The disturbance of hearing is much less in myringitis, although the drum may be swollen and bulged; in fact, the hearing distance is not much affected. The other subjective symptoms are similar in the two affections. Little vesicles often develop on the membrane.

These burst and leave the membrane looking red, injected, and macerated.

Impacted wax may be forced against the drum and cause pain, deafness, tinnitus, and other ear symptoms, and its diagnosis is made by means of the speculum. If the ear drum is not injured, no serious signs nor symptoms remain after its removal. If there are many hairs in the canal they may be pushed aside by rotating the speculum. Bone conduction is good.

Rupture of the membrane tympani has a history of injury, some pain, decreased hearing power, and examination reveals the rent in the membrane, the edges of which are covered with blood. There are no inflammatory symptoms unless it becomes subsequently infected. The patient may hear a gush of air when he blows his nose or swallows. The rupture is usually in the anterior half, if caused by direct violence, and in the posterior half, if due to indirect violence.

Otitis media acuta nearly always occurs from extension of inflammation from the nose and throat. Yet, sea bathing is a rather frequent cause. Etiologically considered, the "Neptune's party" was sea bathing intensified. In otitis media there are the usual symptoms of earache, deafness, tinnitus, headache, and, perhaps, fever with its associated phenomena, depending on the severity of the inflammation. The pain is usually dull and throbbing. It is apt to be continuous, with sharp exacerbations. It is worse at night and is made worse by pressure on the tragus and by opening the mouth widely. Autophony and diplacusis are often noted. The appearance of the membrana tympani varies according to the degree of the infection. In mild cases and in the catarrhal type there is less trouble than in the purulent types. In the catarrhal type the membrane is congested, especially Shrapnell's membrane and the long handle of the malleus. The membrane is red, angry looking, and the short process is nearly obliterated except for appearing as a yellowish dot. There may or may not be bulging of the membrane. If present, it may be in Shrapnell's membrane, the posterior superior quadrant, or the posterior inferior quadrant. In the purulent type the membrane is much more affected and the landmarks are all practically obliterated, and the osseous external canal is involved, making it difficult to tell it from the drumhead. Bulging is practically always present and is usually early and marked. In myringitis the pain is not so severe and there is less trouble of hearing. Mucus of a stringy type is in the discharge from middle-ear disease, but is not present in otitis externa, diffuse or circumscribed.

Mastoiditis acute has history of ear trouble, pain over mastoid, tenderness on pressure and percussion, increased surface temperature on affected side, fever with its associated phenomena, swelling and

redness over the mastoid, and temporary partial cessation of the discharge from the ear. There is usually a high white cell count with a large percentage of polymorphonuclears. On examination, the superior and posterior parts of the external canal show drooping and, if the membrane is not open, it will also droop at its upper and posterior part. A discharge from the ear soon begins again and is apt to be profuse. It is to be remembered that furunculosis may cause pain, redness, edema, and tenderness over the mastoid and a careful examination of the ear must be made. Transillumination and the X ray may aid in the diagnosis of mastoid disease.

An *infected sebaceous cyst* may resemble a furuncle, but is more circumscribed, less edematous and red, and on incision, it shows a small cavity filled with liquid pus and secretions.

Treatment Briefly Summarized

Otitis externa diffusa, if slight, calls for instillations of boric acid solution, cocain, 4 per cent in sterile oil, or a 10 per cent solution of opium in sterile oil. In cases of any moment incisions are usually necessary and should be made deep and thorough and be followed by mercurochrome, boric acid, zinc oxide, or some other antiseptic.

Otitis externa circumscripta usually calls for incision and drainage, followed by applications of antiseptics, such as bichloride solution or boric acid. In mild or early cases a tampon of carbolic in glycerin, menthol, or Burrow's solution as advocated by Bacon.[1] Aluminum acetate is also used by some.

It is important in cases of *rupture of the membrana tympani* to do nothing except put a piece of cotton in the external auditory canal. If suppuration ensues, then treament for that condition is instituted. In *myringitis* insufflation of boric acid powder or zinc oxide and boric acid is usually all that is needed. *Cerumen inspissatum* calls for shrinking of the wax with a mixture of glycerin, sodium bicarbonate, and water and subsequent removal by careful irrigation. If the drum is retracted, a Politzer bag may be used. It is wise to put a few drops of argyrol or mercurochrome in the external canal, as it may prevent otitis externa from developing. A piece of cotton is to be left in the meatus for the rest of the day.

Otitis media requires incision of the drum in all cases with bulging of the membrana tympani. In mild cases of otitis media, with no bulging of the drumhead, heat and irrigations suffice.

Mastoiditis is to be operated upon if it does not subside after making a free incision in the drum and establishing adequate drainage.

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[1] Bacon, G: A Manual of Otology, 7th edition, Lea and Febiger, Philadelphia.

Conclusions

1. "Neptune's party" was the cause of a considerable number of ear affections. Middle-ear disease and its complication, mastoiditis, were undoubtedly due to the continuous ducking followed by gagging, coughing, strangling, and nose blowing which forced water containing bacteria from the nose and throat into the Eustachian tube. Most cases were of the catarrhal type, due probably to the fact that the nose and throat were not acutely inflamed. A few purulent cases resulted.

2. Two cases had ruptured ear drums and one of these developed acute purulent otitis media from it. The forceful stream of water from the hose probably caused the rupture. It also caused the wax to be driven against the drum in the cases of impacted wax. The external canal infections were undoubtedly due to both the stream of water and the submersion in the tank. One thousand three hundred men put through the tank caused considerable pollution, although there was some change of water.

3. The usual symptoms were noted, but fever was uncommon, as a whole.

4. It is important to know the appearance of the normal external auditory canal and membrana tympani because it is on the altered condition of these structures that a differential diagnosis of the different ear affections is mainly based. It is well to bear in mind that a patient may have more than one disease.

5. The hearing is very slightly or not altered in myringitis and external ear affections (unless blocked by swelling).

6. The best treatment for uncomplicated ruptured ear drum is no treatment. A piece of cotton in the ear is sufficient. Never put ear drops in the ear.

7. A convenient preparation to shrink wax before removal is a dram of glycerin and one-half dram of sodium bicarbonate in an ounce of water. The drops are left in 20 minutes to one-half hour before syringing.

8. Although some disagree with this view, I believe every case of acute catarrhal otitis media with definite bulging of the drum should have the membrane incised. Cases treated by me have always done better when incision was made. All agree that purulent cases are to have an immediate paracentesis. The ear drum is to be opened in the posterior half preferably, unless only localized bulging, is present elsewhere. The knife should be held with the sharp edge directed upward and the cut should be made from below upward. The reason for this is the position of the drum in relation to the canal.

9. Drums which have ruptured spontaneously before having been seen should be opened further if drainage is not satisfactory.

10. On account of the number of ear cases caused by the "Neptune party" it would be a good thing to discontinue the "water part" of the program and substitute for it something else.

SARCOMA OF NECK[1]

REPORT OF CASE FOLLOWING TRAUMA

By C. D. Middlestadt, Lieutenant (Junior Grade), Medical Corps, United States Navy

"Sarcoma is a tumor arising from connective tissue and retaining most of the general characteristics of connective tissue, but endowed with new power of invading and actively destroying adjacent structures and of forming colonies of its own tissue in distant organs. In this respect sarcomata are typically malignant tumors." Such is the definition laid down by MacCallum, and which gives a very clear and concise picture of one of the worst, most dreaded, and hopeless diseases that we are called upon to treat. The tumors appear to originate from the cells of the connective tissue, and are hence of almost universal distribution. Indeed, there is scarcely any tissue or organ of the body in which sarcoma may not originate.

While sarcomata may originate in any kind of connective tissue, their cells are quite unlike those of the normal tissue in appearance and totally unlike them in their biological characters. They are characterized by the energy and rapidity of growth of their cells, and this in itself brings about the striking morphological difference between them and the corresponding benign tumors arising from similar situations in the connective tissue. The malignant character of the tumor is evident in the infiltrating, destructive manner of its growth when it is well established, and, after removal by operation, the tendency to recur in the same place from traces of the tissue left behind.

There is considerable difficulty in outlining this group of tumors, as various pathologists have originated their own classifications. Some speak of malignant tumors arising from muscle or neuroglia by such names as myosarcoma and gliosarcoma, while others prefer to speak of them as malignant myomata and malignant gliomata. A classification which is widely used is one in which the type of sarcoma is distinguished from another chiefly by the form of its cells and by the character of its intracellular substance, as well as its energy of growth. This classification is as follows: Spindle cell, mixed cell, round cell, giant cell, and alveolar. In spite of the

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[1] From United States Naval Hospital, New York, N. Y.

nebulous state of mind as to the real relations of these questionable growths, there remain many well-defined sarcomata which in any series of cases stand out sharply as easily recognized representatives of certain groups.

Etiology

The cause of sarcoma is unknown. It is chiefly a tumor of youth and early adult life, but may occur at any age. It is sometimes congenital and may occur from infancy to extreme old age. A few observers have claimed to find in and among the cells of the tumor certain parasitic protozoa, but nothing definite is known of the nature of these bodies. Many cases appear to follow traumatic injury, but the majority arise independently of any recognizable cause.

Sarcomata are usually rounded, more or less lobulated, irregular growths, which form nodes, either embedded, sessile, pedunculated, or pendulous. They may be encapsulated and are usually well circumscribed.

Their irregular blood supply makes retrogressive changes common. The most frequent are necrosis and mucoid degeneration. Some degenerate almost as rapidly as they form, others degenerate locally as their nutrition fails. The rapidity of growth seems to depend upon the character of the cells as well as upon their nutrition. The round-cell tumors grow most rapidly, especially when highly vascular.

Sarcomata vary through all degrees of malignancy. Some are certainly and rapidly fatal; others liable to recur after excision or amputation. Some remain purely local and disorganize the tissue in which they grow; some rapidly infiltrate other organs; and some are never observed to recur after excision. The general tendency is to recurrence. Secondary deposits are formed almost exclusively through the blood vessels. The small spindle cell and giant cell sarcomata recur locally and are less apt to form secondary deposits.

Sarcomata show remarkable disposition to invade and grow into the veins, sometimes forming masses several centimeters in length growing in the interior of the larger veins, though still attached to the parent tumor. Such extensions sometimes break off and, if large, may cause fatal embolism.

The spindle-cell sarcoma is malignant according to size and looseness of the cells. Thus, the small spindle-cell sarcoma is less malignant than the large spindle-cell tumor, and the fibrosarcoma is the least malignant of all. The circumscribed and encapsulated ones are much less malignant than the infiltrative forms. The malignancy consists in destructive compression and erosion of the tissue in which they grow, in recurrence after excision, and in secondary deposits of various organs of the body.

REPORT OF CASE

H. M. D., Ph. M. 2 c., U. S. N., age 24, admitted to hospital with diagnosis of Sarcoma of neck, June 10, 1925.

Family history: Negative.

Past history: Irrelevant.

Habits: Good.

Injuries: Kicked in back of neck, fall of 1923, while playing football.

Complaint: Swelling and tumor masses on posterior aspect of neck, causing limitation of motion.

Present history: While playing football in September, 1923, patient was injured by being kicked in back of neck. Injury did not bother him much at the time. Nine months following this injury he noticed a tumor mass near the base of the skull on posterior aspect of neck which caused impairment of motion. He was admitted to the naval hospital, Norfolk, Va., September 16, 1924, with the diagnosis of cyst of neck. Physical examination revealed a soft sessile mass on the neck near the base of the skull. On September 17, 1924, he was operated upon and cyst was removed from under the muscle of neck. No pathological study was made of the cyst and incision healed in a few days. He returned to duty September 30, 1924.

Readmitted to Norfolk Naval Hospital February 9, 1925, with diagnosis of cyst of neck. He complained of a growth at base of skull, right side, at site of previous operation. This was painful to touch. Patient stated that two months after operation, he noticed growth was returning and that it has steadily increased in size. It interfered with the movement of his head and was very painful to touch.

Physical examination revealed a mass about twice the size of a golf ball, very hard and nonmovable. Operation, February 10, 1925. Removed a tumor mass which had involved the muscles and fossae of the neck from the base of the skull down the neck for about 3 inches. The mass was very adherent, making it necessary to remove the periosteum at the base of the skull, as it appeared to be the site of origin. The wound healed nicely.

Specimen was sent to the Naval Medical School at Washington, D. C., where a diagnosis of fibrosarcoma, malignant, was made. Pathological report was as follows:

> Specimen consists of bundles of muscle fibers, fibrous tissue, and blood vessels. In one portion the fibrous tissue appears very embryonic and the cells definitely infiltrate the surrounding tissues. Nuclear figures are seen throughout. From the appearance of the cells and tissue in general, it is believed to be a rather early sarcomatous growth.

Patient appeared before Board of Medical Survey, February 23, 1925, whose findings were as follows: *Diagnosis:* Sarcoma of neck. *Origin:* Line of duty. Disability is not the result of own misconduct. *Present condition:* Unfit for duty. *Recommendation:* That he be transferred to United States Naval Hospital, Washington, D. C., for radium treatment.

Admitted to United States Naval Hospital, Washington, D. C., March 8, 1925, for radium treatment. During the period from March 16, 1925, to May 27, 1925, the patient received superficial and deep X-ray therapy, with apparently very little result. His condition was considered improved, but there had been some increase in the size of the tumor. It was recommended that the patient receive radium therapy.

Patient was admitted to this hospital June 10, 1925, for purpose of receiving radium therapy. Upon admission, his condition was as follows:

Strong, well-developed young man of athletic build, compelled to hold his head in one position. Has the appearance of one suffering from stiff neck. Tonsils chronically diseased, full of free pus. Axillary lymph nodes enlarged

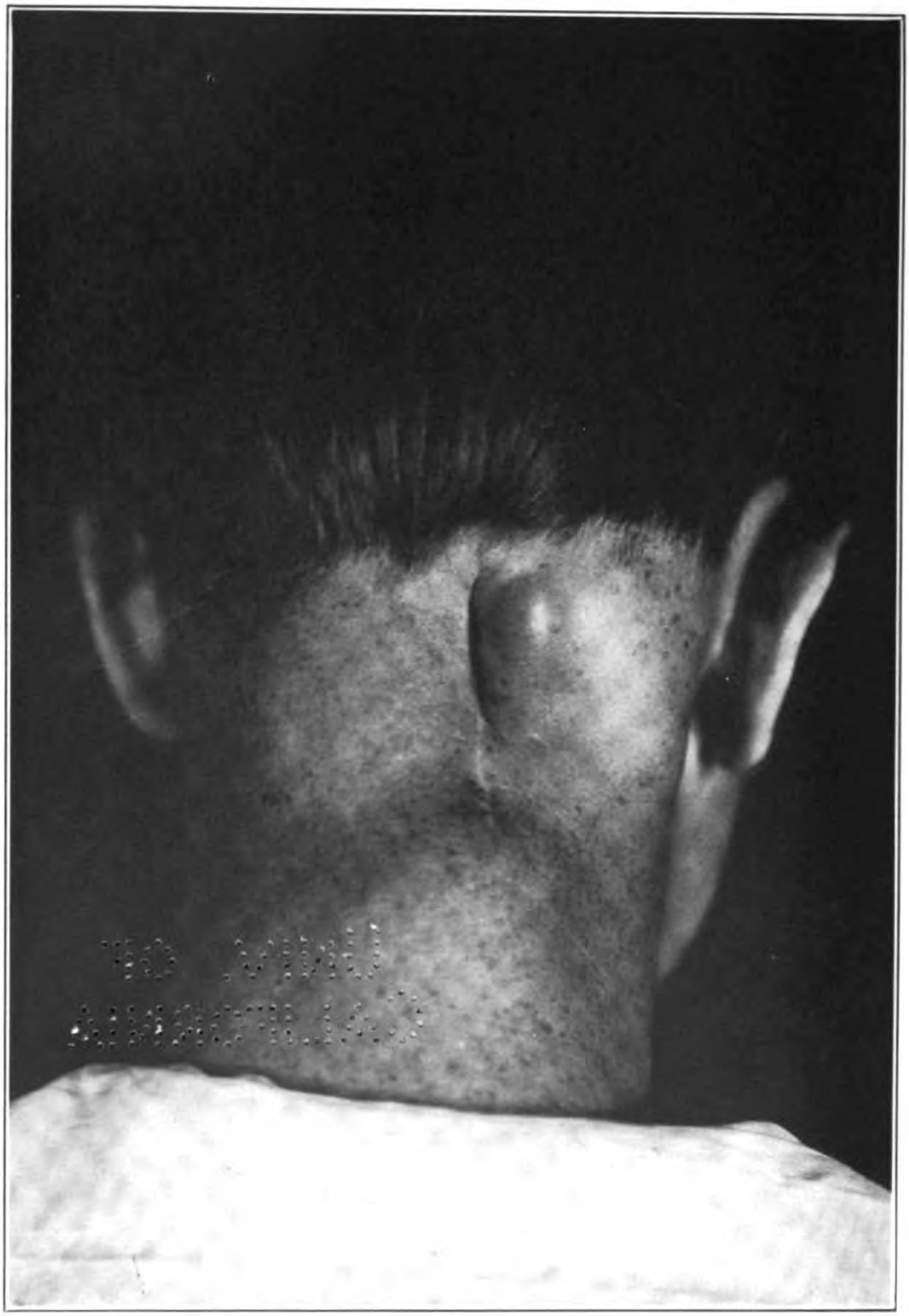

FIG. 1.—SARCOMA OF THE NECK

and indurated, more marked on right side. There were three well-defined tumor masses on posterior aspect of neck extending from the base of the skull to the seventh cervical vertebra. (Fig. 1.) The superior mass measured 3 by 2½ inches, was irregular in outline, indurated, hard, and nonmovable. The skin over the tumor, apparently under tension, appeared thin and glistening. It appeared as if it was in the process of degeneration. The second mass was situated a little lower and more to the left of midline than to the right. It was about 3 inches in diameter, round, indurated, and adherent. Between the two superior masses there was a scar about 3 inches in length, the site of two former operations.

The third and inferior mass was about 3 inches in diameter, situated at the lower end of the scar and had about the same appearance as the second mass. The two latter masses are nearly symmetrical in their distribution.

Knee jerks: Absent.

Laboratory report: Urine negative for sugar, albumen, and casts. Also negative for Bence-Jones bodies. Wassermann reaction, negative. Hgb., 96 per cent; W. B. C., 7,500; Polys., 75 per cent; Lympho., 22 per cent; Eosinophiles, 1 per cent.

X-ray examination of chest: Negative for secondary deposits.

Patient was seen in consultation with Doctor Muller, who took him to Memorial Hospital, New York. Here it was decided that radium and deep X-ray therapy would be of no benefit. The growth was considered to be of neurogenic origin, and it was decided that surgery was indicated.

When the patient arrived, June 10, 1925, he was apparently feeling very well. He was able to get about, play ball with other corpsmen, and enjoy life. About one week after admission he started having pain in the superior tumor mass. This gradually increased until he was confined to bed, being unable to be up and about on account of pain. The mass was apparently larger and appeared to be fluctuant. The other two masses were also increasing in size but did not cause pain as did the superior one. The superior mass appeared to contain pus and an attempt was made to aspirate it. The material obtained was examined under the microscope and found to contain a mass of undifferentiated cells with large oval and fusiform nuclei.

They were of the type found in the large spindle-cell sarcoma.

The patient was sent to the Neurological Institute for examination on recommendation of the Memorial Hospital. Before a final decision was made, it was advised that the patient be given two injections of salvarsan to rule out gummata, as several cases quite similar to this, in which salvarsan had been of definite value, had recently been seen.

After receiving the two injections of salvarsan the patient apparently has not been relieved of any of his symptoms and the tumor mass is steadily increasing in size. Several slight hemorrhages have followed the aspiration.

Although the work on this patient has not yet been completed, it has seemed worth while to report it before the staff. Further developments and the outcome will be watched with interest.

ACUTE INTESTINAL OBSTRUCTION—WITH REPORT OF TWO CASES [1]

By K. E. LOWMAN, Lieutenant Commander, Medical Corps, United States Navy

In this paper it will not be our effort to discuss acute intestinal obstruction in full, for indeed it is too broad a subject for a short

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[1] Read before the Norfolk Medical Society, Norfolk, Va., Oct. 12, 1925.

discussion, but rather we shall attempt to make a few general remarks on the subject before presenting the report of two rather recent cases, which, we trust, will be of some interest to you here assembled this evening.

Intestinal obstruction is a condition in which fecal movement is mechanically impeded or prevented. Acute obstruction is due to a sudden narrowing or occlusion of the lumen of a portion of the intestine. (Da Costa.)

As to the etiology of this grave surgical condition we can not here go too much in detail, since the causes of acute intestinal obstruction are numerous in the extreme. We may mention, however, obstruction by adhesions or adhesive bands; by volvulus or twisting of a loop of gut upon its mesenteric axis; by intussusception, consisting of the intussusceptum sheathed within the intussuscipiens; by foreign bodies, gallstones, and enteroliths; by internal herniæ; by Meckel's diverticulum, a structure due to the persistence of the vitelline or omphalomesenteric duct, coming off from the ileum anywhere from 1 to 3 feet above the ileocecal valve, and present in about 2 per cent of persons, according to Da Costa; obstruction by tumors within or without the enteric lumen; and by obstruction from fecal accumulation.

Symptoms

In regard to the symptoms of acute obstruction, these, as we know, are most grave: the onset is sudden, marked by shock, pain, and vomiting. Nausea and vomiting are the rule, especially in obstructions of the small intestine, although very often noticeable also in obstruction of the large bowel.

The tighter the restriction, the more sudden the onset, and the gravity of shock is in direct ratio to the amount of the enteric tract involved. Pain, due to distention and the local peritonitis, is frequently very agonizing in character, but varies in intensity. Pain is said to be the more marked the higher the enteric occlusion. Tenderness and rigidity come on with the advent of peritonitis. Vomiting does not relieve the pain and comes on after the pain symptom, is continuous in character, and is usually without cessation. The stomach contents are first to appear, then the character of the vomitus changes to a bilious one, and, lastly, appears the stinking fluid, either brown or yellow in hue, which is characterized as stercoraceous. Some authorities state that true feces is never vomited; others admit it rarely is ever noted.

A characteristic of obstruction is the total inability to pass gas or feces. However, in the very beginning of a case there may be

a bowel movement, caused by intestinal emptying below the site of the occlusion.

The temperature becomes subnormal, the pulse rapid and weak, the tongue and breath very offensive. There is a picture of a marked toxemia. Whether this toxemia is due to a bacteremia or to the formation of certain abnormal toxins, possibly of the cholin group, due either to bacterial decomposition or the abnormal action of the enteric enzymes, is a matter which is causing much discussion at present and is still undecided.

Distention from gas, so-called tympanites, puts in its appearance early. Some authorities claim to be able to locate the obstruction by noting the sites and extent of this distention. In any case the distention, as it progresses, causes pressure upon the diaphragm and the consequent embarrassment of respiration.

Most cases show a tendency to pass into a condition of profound collapse, due to the terrible toxemia and also to the robbing of fluids from the blood by the excessive vomiting and sweating. There is a striking fall in the blood chlorids and a great increase of the non-protein nitrogen on account of the destruction of body protein.

The urinary secretion is checked, almost completely if not entirely, the fluid being highly nitrogenous in character. Indican appears upon or after the second day. Leukocytosis of anywhere from 15,000 to 30,000 is noted as a rule.

Diagnosis

The diagnosis of acute intestinal obstruction is necessarily rather easily determined when the symptoms hitherto mentioned are noted. In acute cases the sudden occurrence of pain and the consequent nausea and characteristic vomiting, the suppression of urine, the inability to pass gas and feces, and the final prostration and collapse leave little doubt in our minds as to the determination of the cause of the trouble.

Etiology

Intussusception is the common cause of intestinal obstruction in children, but it may also occur in adults. Osler claims that, in children, at least 60 per cent show positive palpatory findings indicative of intussusception. We must not forget also that, in cases of intussusception, bloody mucus is passed frequently.

Volvulus, which has for its favorite site the pelvic colon, occurs more frequently in males than females, and most often in those of middle age. It is, as we would suspect, usually preceded by constipation. In volvulus the symptoms come on, as Da Costa describes it, "with explosive suddenness." "Obstruction is absolute, vomiting is late and rarely stercoraceous, no tumour can be detected;

* * * collapse is not so rapid nor so grave as in obstruction from bands and internal hernia." Tenderness makes its appearance soon, and means severe peritoneal inflammation.

Treatment

Treatment of acute intestinal obstruction is, as it has been expressed in Nelson's Loose Leaf Medicine, "obviously surgical." In the acute cases of obstruction the diagnosis of the condition early is the crux of the situation; the earlier the diagnosis the less the chance of eventual death. Early recourse to surgical procedure is, absolutely essential, our only chance to prevent a fatal issue in the great majority of cases. To open the abdomen before collapse ensues should always be our purpose.

In acute obstruction it is always a wise surgeon who, before operation, empties the stomach by lavage and the lower bowel by copious enemata, keeping the patient in a knee-chest position while this is being done.

According to Da Costa, "every operation is exploratory. If in doubt as to whether the obstruction is in the ileum or the colon, open the abdomen through the lower half of the right rectus muscle. The incision should admit the hand, and the hand prevent extrusion of the intestines. The cecum is sought for first. If it is distended, the obstruction is distal. Systematic search finds where distended bowel ends and collapsed bowel begins, and this point is the seat of the obstruction."

REPORT OF CASES

The following is a report of two cases which have recently come under our observation at the Norfolk Naval Hospital.

Case 1.—J. L. A.; seaman, second class; about 20 years of age. We shall quote from his clinical record as kept at that institution.

Admitted April 8, 1925, with "Diagnosis undetermined." Patient upon admission complains of pains over the abdomen, somewhat localized over old appendectomy scar. States that attack came on suddenly about 15 hours previous to admission. Attack characterized by abdominal pain, colicky in character, gradually becoming more intense, and followed soon by nausea and vomiting. Pain is not referred to other parts of body; no symptoms suggestive of renal calculus. No history of jaundice.

Had one similar attack four months ago, lasting one night, but was relieved by hypodermic and reported for duty the next morning. Acute appendicitis with appendectomy for same in 1920, five years ago. Operated upon in 1924 for ventral hernia at upper angle of scar from previous appendectomy. Venereal history, negative.

Temperature, 98.6° F., pulse, 88 per minute; respirations, 20 per minute. Heart and lungs, apparently normal. Abdomen shows scar for previous operations over appendiceal region; some rigidity of right rectus and moderate tenderness over lower abdomen, more pronounced over right lower quadrant. Extremities and genitalia negative.

Urine, negative except for high specific gravity. *Blood:* Coagulation rate, 3¼ minutes; W. B. C., 17,300; Polys., 85 per cent; S. L., 12 per cent; Trans., 1 per cent. S. S. enema given; poor results. Gastric lavage done.

Next day, April 9, 1925, condition unimproved. Patient complains of periodic seizures of pain in abdomen; hyper-peristalsis present. S. S. enemata—poor results. W. B. C., 8,050; Polys., 63 per cent; S. L., 27 per cent; L. L., 5 per cent; Trans., 5 per cent. Temperature, 99.2° F.; pulse, 88; respirations, 22. Patient nauseated and vomiting greenish fluid which is strongly positive for bile, as reported by laboratory. Urinalysis, negative except for high specific gravity.

April 10, 1925, 48 hours after admission. Abdomen distended and tympanitic; more and more rigidity present; also very tender. Patient has been receiving nothing by mouth since entrance to hospital, but has been receiving proctoclysis of 5 per cent glucose solution at intervals. Vomiting continues. W. B. C., 11,000; Polys., 73 per cent; S. L., 22 per cent; L. L., 3 per cent; Trans., 1 per cent; Mono., 1 per cent. S. S. enemata with turpentine; no results.

April 11, 1925. Condition about same. Temperature 99.4° F.; pulse, 80; respirations, 22. Operation decided upon. Ether anesthesia, right rectus incision; considerably more fluid than normal noted upon entering abdominal cavity. Adhesive band found slightly to right of upper part of opening into free abdominal cavity, and binding down one of the coils of the small intestine. Band ligated, doubly, incised, and ends treated with sterile vaseline. Intestine under band found distended but not discolored; no other bands found or other obstruction noted. Incision sutured with cigaret drain in place.

April 12, 1925. Still complains of abdominal pain; abdomen distended and tympanitic. S. S. enema with turpentine and pituitrin given. Continuation of proctoclysis. Wound dressed; moderate amount of sero-sanguineous drainage.

April 13, 1925. Diagnosis has been changed to intestinal obstruction, from external causes, adhesive bands. Wound being dressed daily and cigaret drain withdrawn about one-half inch at each dressing. Slight amount of sero-sanguineous drainage. Abdominal pain still present.

April 17, 1925. Tympany of abdomen quite pronounced. Pain more intense.

April 18, 1925. Patient's constitutional condition very poor; rapidly becoming toxic and approaching collapse. Temperature subnormal, pulse rapid and wiry.

April 19, 1925. About 2 p. m., this date, stercoraceous vomiting began. Becoming more toxic; nearer collapse. After consultation, operation decided upon. To operating room. Ether anesthesia. Lower part of operative wound of April 11, 1925, loosened up and enlarged toward pubis. Enterostomy tube in lower ileum and about 2,000 cubic centimeters of liquid fecal material freed. Two small drainage tubes inserted at upper and lower parts of wound. Patient to ward in fair condition. As soon as he rallied from anesthesia, proctoclysis of 500 cubic centimeters of 5 per cent glucose solution, every four hours, was started. 1.30 a. m., strych. sul., grs. 1/30, by hypo. Pulse ranges between 160 and 170. 2 a. m., hot coffee, by mouth. Patient very restless and cyanotic. 5 a. m., becomes irrational, pulse imperceptible, body cold and blue. Adrenalin chloride 1 cubic centimeter, hypodermically. Strong coffee, per rectum. 6.25 a. m., dying. 6.35 a. m., patient died.

The autopsy report as to the condition found in the abdominal cavity was as follows: The omentum was inflamed and adherent to the intestines. About 200 cubic centimeters of bloody, seropurulent fluid present. Intestines acutely inflamed and ileum distended. The lower 12 inches of ileum were

gangrenous, with several loops bound together by adhesions. There was an adhesive band extending across the ileum 1 inch from the ileocecal valve. About 8 inches from lower end of ileum there was an opening through which a drainage tube was inserted. The cecum and ascending colon were covered with, and bound to the posterior abdominal wall by adhesions.

Case 2.—The second case, we are happy to say, offers a brighter picture. Patient E. E. S., F-3c., about 19 years old; admitted to Norfolk Naval Hospital, August 29, 1925, with diagnosis undetermined, suspected intestinal obstruction. Complains of severe colicky pains in upper right abdomen and left lower quadrant.

Onset: Began suddenly about 10 hours previous to admission. *Course:* Since onset pain has become more or less generalized over abdomen. *Previous illness:* Ordinary diseases of childhood. Gonococcus infection of urethra and abscess left axilla since entry into service. Family history negative in this case.

Physical examination reveals a well-developed young adult male. Head, heart, and lungs apparently normal. Abdomen tense and board-like to palpation; soreness and tenderness generalized but noted chiefly over entire lower abdomen. Genitalia and extremities, negative.

To bed, nothing by mouth; gastric lavage and enema at once. Urine scant in amount and of high specific gravity, with albumin present. Blood shows a moderate leukocytosis. Rectal examination reveals nothing of import. Mass, not soft, but slightly compressible, noted in left lower abominal quadrant, extending slightly above upper border of same.

Temperature, 99.6° F.; pulse, 90; respirations, 23; no vomiting; no signs of approaching collapse.

Under bombardment by enemata, finally, after a lapse of several hours, an enormous amount of hard fecal matter was expelled. After about 20 hours, patient had one natural bowel movement.

Two days after admission distention and soreness have completely disappeared; patient very comfortable. Enemata at intervals: Mineral oil daily. Diagnosis has been changed to intestinal obstruction, from internal causes (fecal masses).

Patient, after being kept under surveillance until September 15, 1925, was discharged to duty, well.

REFERENCES

Da Costa, J. C.: Modern Surgery, 9th edition, W. B. Saunders Co., 1925.

Osler and McCrae: Principles and Practice of Medicine, 10th edition, D. Appleton and Co., 1925.

Nelson's Loose Leaf Living Medicine, Thomas Nelson & Sons, 1924.

CONSERVATIVE TREATMENT OF BUBOES[1]

By J. M. Barnes, Lieutenant (Junior Grade), Medical Corps, United States Navy

The conservative treatment of buboes is not new, yet it is so little used that it seems worth while to review the essentials of the treatment and compare the results with those obtained with the time-honored method of incision and draining.

[1] From United States Naval Hospital, Norfolk, Va.

Keyes recommends multiple small punctures and packing with iodoform and glycerin. He claims that by this method secondary infection is usually avoided, provided the incisions are small.

Others recommend complete excision at the outset, with subsequent closure by suture.

Recently, Reenstierna (6) reported the results of 153 cases of chancroidal bubo which were treated conservatively. His treatment consists, essentially, of foreign protein shock and the local application of heat. He claims that in cases in which the bubo had not been opened and exposed to secondary infection involution usually occurred in one week.

While the series of cases treated conservatively at this hospital in the last two months is not very large, the results are highly promising.

The inguinal adenitis most frequently arises with or follows a penile ulcer, chancroidal ulcer being the most common one of these. In young adult males this is by far the most frequent cause of suppurating buboes (4).

The penile sore appears in from one to eight days after exposure and, if carefully and properly treated, heals, in the majority of cases, with little or no lymph-node involvement. Rest in bed and cleanliness of the parts, with the application of mild germicidal agents, constitute the main defense in preventing buboes. However, in many cases the lymph nodes become involved, due either to increased virulence of the organism, decreased resistance of the patient, or inadequate treatment. It would seem that in most instances the latter is chiefly responsible, since the individual who is uncleanly enough to allow the ulcer to occur is usually indifferent about washing the parts after it has fully developed. Irritation of the clothing and the presence of a long or tight foreskin aid in secondarily infecting the existing sore and increase the percentage of buboes.

The infecting organisms and their toxins then ascend the lymphatic channels to involve the nodes (2). The virulent material enters the cortical portion of the nodes and there sets up an acute inflammatory reaction to which is soon added a proliferative phenomenon.

This is shown by the mitotic figures and lymphoblastic proliferation (3).

The medullary portions and the periglandular tissues are then encroached upon and become permeated with the virulent material so that the entire system of lymph nodes in the region may be matted together in an enlarged succulent mass with reparative and inflammatory reactions occurring side by side. Certain regions may break down—liquefaction necrosis—and we have multiple small abscesses

gradually fusing to form larger pockets or the perinodal tissues alone may suppurate. In either case multilocular abscesses are formed. The deeper nodes discharge their pus toward the skin, the line of least resistance, and become fused into a hard, solid floor for the abscess cavity. At any time the process may be arrested, but, after suppuration and definite fluctuation occur, it is more likely that the abscess will rupture through the skin. It is at this point that incision and drainage are usually resorted to (3) (4).

In many cases suppuration may be forestalled and resolution brought about by rest, diet, attention to bowels, administration of iodides, and foreign protein shock. This treatment has caused regression of the bubo in about five-sixths of the cases treated in Ward 1 during the last two months. In detail, the method is as follows: The patient is put to bed at the first sign of lymph node enlargement and, usually, a hot-water bottle is applied. He is directed not to use the bottle continuously but to keep it in contact with the bubo about 20 minutes out of each hour. Soft diet is given and the bowels are kept open with calomel.

Potassium iodide in 10-grain doses is given three times a day and intramuscular injections of 1 to 2 cubic centimeters of typhobacterin are given every fifth or sixth day. Meanwhile the local treatment of any penile ulcer is carried on daily.

Should the bubo go on to suppuration in spite of the above treatment, it is not touched until palpation shows that the pus is fairly localized in one or two pockets. After such localization has occurred the pus may be withdrawn by puncture through normal tissue and aspiration of the contents. Following this, a rather firm spica is applied and the bed treatment carried on. The puncture treatment has only been necessary in 4 of 24 cases and in all of these was repeated two or more times. In none of these, however, was any growth found on culture and in only one were organisms seen. In this case staphylococci were seen in smears but were evidently too much attenuated to grow on culture media.

The average disability of the four men treated by puncture was 27 days and in one instance the bubo had disappeared before the penile sores had healed.

The average disability of men treated by excision and drainage varies so widely that the extreme had best be given. The shortest disability time was about 40 days and the longest about 5 months. The average duration of the bubo which does not go on to complete suppuration ranged from 10 days to 2 weeks.

In view of the series of cases published by Reenstierna and the favorable results obtained here by somewhat similar methods, it

would seem that the conservative treatment should be given a more thorough and extensive trial and that for the present we forget the knife in buboes.

BIBLIOGRAPHY

1. Delafield and Prudden: Pathology, William Wood and Co., New York.
2. Adami and Nicholls: Systematic Pathology, Lea and Febiger, Philadelphia.
3. Rose and Carless: Manual of Surgery, William Wood and Co., New York.
4. Keyes: Urology, D. Appleton and Co., New York.
5. Hartzell: Diseases of the skin, J. B. Lippincott Co., Philadelphia.
6. Reenstierna, J.: Arch. f. Dermat. u. Syph. 147: 362–388, 1924.

UNUSUAL RESULT IN FRACTURE ABOUT ELBOW JOINT

By R. Hayden, Lieutenant Commander, Medical Corps, United States Navy

The accompanying X-ray photograph shows a remarkable "nature cure" and indicates what can be done by nature in spite of faulty medical treatment.

The patient came to the medical officer to find out if a deformed elbow could be corrected.

History.—Fell down while roller skating about 12 years ago and broke arm. Treated by a physician who "set" the fracture and put it in a plaster case. No X-ray examination made. Present deformity was first noticed by the patient when the cast was removed. The doctor treating the case said this deformity would gradually disappear, but there has been no change.

Examination shows the elbow very much widened and a pronounced lump on the outer and posterior side above the head of the radius. This lump disappears when the elbow is flexed. There is no pain except occasionally when doing heavy lifting. Then there is a sense of tightness and slight drawing pain over the external condyle. The relations of the humeral condyles and the olecranon are very much changed.

Patient has absolutely no restriction of motion in the injured elbow, the right elbow working as well as or better than the left. The right arm is as strong as or stronger than the left. He does his work without any difficulty and states that the deformity does not bother him at all except for looks and an occasional drawing pain over the external condyle.

X-ray report from U. S. S. *Relief*, August 13, 1925, was as follows:

"Examination of right elbow shows an old Y fracture with detachment of external condyle of the humerus, rotation of the fragment 90°. The fragment is apparently attached to the external inferior margin of the remnant of the external condyle of the

humerus. The head of the radius is broadened and flattened. There is fairly well defined joint space existing between the articular surface of the head of the radius and the rotated external condyle. The articulate surface of the internal condyle of the humerus is broadened and flattened. The relations of the olecranon fossa are changed due to the fact that the floor and outer wall are destroyed." (Fig. 1.)

The patient was advised that the present condition of his right elbow joint could not be improved upon so far as usefulness was concerned and that an attempt to improve appearances by removing the excess bone on the outer side of the joint would possibly cause some ankylosis. He was strongly advised to leave well enough alone.

A CARRYING CASE FOR BEDSIDE LABORATORY WORK

By R. E. WEAVER, Chief Pharmacist, United States Navy

The writer used to be considerably inconvenienced by the lack of facilities for carrying from the laboratory to the several wards and back again the equipment used in blood counts, blood cultures, making of smears, and other procedures frequently asked for on bed patients. In many of our large hospitals the wards are located at a great distance from the laboratory and it is often necessary to go out of doors to reach them. The use of dressing or instrument trays has many disadvantages; they are awkward to carry, and material on them upsets easily, may become wet if carried in the rain, or may be blown off if carried out in the wind.

About a year ago I conceived the happy expedient of fitting up one of the Navy standard microscope accessory cases for bedside laboratory work, and this scheme has proved so convenient that the idea may be of use to other laboratory workers. The case is kept in the laboratory, constantly ready for use, and is fitted with the following equipment:

Tallquist hemoglobinometer.
Two red-count pipettes.
Two white-count pipettes.
White-count diluting fluid.
Red-count diluting fluid.
Puncture needle in alcohol.
Platinum loop.
Sterile needles for venous puncture.
Box of matches.
Clean slides.
Alcohol lamp.
Grease pencil.
Rubber tubing.
Rubber bands.
Sterile gauze.
Bottle iodine.
Bottle sterile NaCl solution.

The various compartments and trays in the accessory case make the storage and safe carrying of these items easily possible, and there is still room for additional material such as 100-cubic centimeter

FIG. 1. —CONDITION OF ELBOW JOINT TWELVE YEARS AFTER INJURY. NOTE THE CHANGED RELATIONS OF THE CONDYLES AND OLECRANON

flasks of culture media, tubes of melted agar in tumblers of hot water, etc., when special procedures are indicated. The box, having a handle on the top, is easly carried. In order to safeguard against picking up the case without having it fastened shut, we keep the key in ours and make it a rule always to turn the key as well as to fasten the two metal clasps. When blood-counting pipettes or any other articles in the box are used they are immediately cleaned and returned, so that the case is always ready for any ward work that may be required.

IRITIS DUE TO SODIUM IODIDE—REPORT OF CASE[1]

By J. L. EMENHISER, Lieutenant (Junior Grade), Medical Corps, United States Navy

K. J., a Veteran's Bureau patient, was admitted to this hospital with a diagnosis of articular rheumatism of gonorrheal origin. He complained of constant pain in his back, hips, knees, ankles, and toes, made worse by exercise. Onset of the condition followed a gonococcus infection of the urethra in 1918 while in the service in France. Practically every joint in his body has at some time been infected. Family history is unknown and personal history is otherwise negative.

The patient is a well-developed, poorly nourished male, about 30 years of age. He walks with a decided limp and uses a cane. *Chest examination* revealed the following: Chest, long and narrow; expansion, poor, especially over the upper lobe, left lung; apices, markedly retracted; a few tender glands. There are several small areas on chest which are markedly tender on percussion. Apices are dull on percussion. Dullness extends down to the level of the fourth rib, anteriorly, on the left, and to the level of the lower third of the scapula, posteriorly. Breath sounds are everywhere feeble and expiration prolonged. Many persistent crepitant and subcrepitant rales are heard throughout upper part of each lung, extending well below clavicles anteriorly and along inner borders of scapula posteriorly, especially on the left.

The lower dorsal and lumbar regions of the spine are rigid. Attempts at movement produce pain. All joints of the lower extremities are painful on motion.

There is a scar on the penis about half the size of a cent, on the mucous membrane behind the glans, dorsally. There are scars in both inguinal regions. A profuse, creamy urethral discharge is present. Physical examination is otherwise negative.

Laboratory.—Urine negative. Wassermann negative, both antigens. Sputum negative for tubercle bacilli. Smear positive for gonococci.

X-ray examination of chest.—Heart and arch negative. Some calcified lymph nodules in the hila. Some productive changes in the bronchial walls of both lower lobes.

X-ray examination of os calci.—There is a small exostosis on the posterior surface of the right and a large exostosis, about 1 centimeter long, on the inferior surface of the left os calcis.

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[1] From United States Naval Hospital, New York.

The patient was put upon regular routine treatment for gonorrhea. This included rest in bed and liquid diet, together with the usual urethral injections. On May 20, 1925, all symptoms of the urethitis had subsided, but the patient still complained of much pain in all joints previously affected. In addition both ankles were swollen and inflamed. At this time it was decided to give 1 gram of sodium iodide intravenously, twice daily.

May 23, 1925.—Ankles normal in size and appearance. Patient complains of pain only in legs and feet, especially in left heel.

May 25, 1925.—Legs and feet still painful. Patient has developed iritis, left eye. On consultation, atropine sulphate, 2 per cent, one drop twice daily into eye and warm boric acid packs were advised. Attempts at establishing the etiology of the iritis were unsuccessful. It was advised that the sodium iodide be discontinued.

June 2, 1925.—Left eye practically normal. Condition of legs and feet unchanged.

June 8, 1925, Sodium iodide treatment continued this date.

June 10, 1925.—Iritis is returning. Iodides discontinued and eye treatment resumed.

June 22, 1925.—Eye normal. Ankles are practically normal, but heels still painful, especially left.

This case is interesting in view of the increasing use of iodides intravenously.

THE AGE FACTOR IN MAJOR SURGERY

By C. W. Lane, Lieutenant, Medical Corps, United States Navy

It is worthy of note that patients past 60 stand major operations very well. Age in itself should not be looked upon as a contraindication to surgery. It is a regrettable fact that, too often, elderly people are advised against surgery merely because of their age. It is interesting to see the large number of patients past 60 operated upon in the large clinics. The general condition of the patient should be the guide in surgical selection, not the age.

In reviewing 100 consecutive major operations done in 1920, I find the age of 10 of these patients to be over 60. The character of the surgery necessary was a real test of the ability of the subject to withstand major work. Seven were done under general, ether, anesthesia and three under local, procaine, anesthesia. To-day, with the advancement made in regional anesthesia, it would be better to do a greater percentage under that method. However, these cases stood ether perfectly.

The 10 cases are briefly outlined.

Case 1.—Female; age, 70. Acute cholecystitis; cholelithiasis. Operation: Separation of adhesions; removal of gallstones and drainage of gall bladder: duration, 58 minutes. Anesthetic: Ether; amount, 150 cubic centimeters. Result: Excellent; discharged 29 days after operation.

Case 2.—Female, age, 70. Procidentia. Operation: Vaginal hysterectomy and repair of perineum; duration, 2 hours. Anesthetic: Ether; amount used,

230 cubic centimeters. Result: Did very well; no evident lack of recuperative ability.

Case 3.—Male; age, 68. Hernia, inguinal, strangulated. Operation: Herniotomy; duration, 1 hour 5 minutes. Anesthetic: Ether; amount used, 210 cubic centimeters. Result: Excellent.

Case 4.—Female; age, 71. Carcinoma of breast. Operation: Radical breast amputation; duration of operation, 1 hour and 15 minutes. Anesthetic: Ether; amount used, 200 cubic centimeters. Result: Excellent; no recurrence in 18 months.

Case 5.—Female; age, 66. Uterine prolapse. Operation: Vaginal hysterectomy; duration, 1 hour 50 minutes. Anesthetic: Ether; amount used, 250 cubic centimeters. Result: Patient withstood the operation quite well.

Case 6.—Male; age, 70. Hypertrophy of prostate and vesical calculi. Operation: Two step suprapubic; (*a*) cystostomy and removal of stones; ether, 200 cubic centimeters; duration of operation, 1 hour; (*b*) prostatectomy; ether, 180 cubic centimeters; duration of operation, 40 minutes. Result: Patient did very well and was discharged in apparently good condition 30 days after the second operation; he died several months later from an extraperitoneal, pelvic abscess; the prostate removed at operation contained pus.

Case 7.—Male; age, 60. Urethral calculi and vesical calculi. Operation: Perineal section; removal of stones, perineal cystostomy; duration, 1 hour 5 minutes. Anesthetic: Ether; amount, 210 cubic centimeters. Result: Excellent.

Case 8.—Male; age 81. Hernia, inguinal; hydrocele of tunica vaginalis. Operation: Bassini repair of hernia; bottle operation for hydrocele; duration of operation, 1 hour 25 minutes. Anesthetic: Novocaine, 2½ per cent, 38 cubic centimeters; local. Result: Excellent.

Case 9.—Male; age, 63. Hernia, inguinal, strangulated. Operation: Herniotomy—Bassini; duration of operation, 1 hour. Anesthetic: Novocaine, 1 per cent, 40 cubic centimeters; local. Result: Excellent.

Case 10.—Male; age, 61. Hernia, right inguinal; myocarditis chronic, moderate degree. Operation: Herniotomy—Bassini. Anesthetic: Novocaine, 2 per cent; local. Result: Excellent.

I have amputated through the thigh under local anesthesia on one woman said to be 100 years of age for dry gangrene, and on another case, over 90 years of age, for moist gangrene. Both cases were septic when admitted and in poor condition, but, even so, they withstood the shock well, the first living for five days and the second for two days, both succumbing to general sepsis.

Of course these latter cases were not of the selected variety, but they do serve to illustrate the remarkable vitality of elderly people.

The success which is now obtained in prostatectomy in the large genitourinary clinics is largely due to the preoperative care given these cases. This holds true in any operative work undertaken upon elderly patients. Success or failure may depend upon this point. By careful selection and by special preparation before surgery is attempted, these patients can be carried through major surgical procedures with surprising success. Regional anesthesia will play a more and more prominent rôle in the future.

Unless the case is an emergency one, the patient should remain in the hospital for at least 10 days before the operation. During this

period proper elimination is maintained by special attention to the skin, bowels, and kidneys. The patient should become accustomed to drinking larger quantities of water. The administration of tincture of digitalis has been found of special value as a heart tonic and kidney stimulant. High blood pressure is not a contraindication to digitalis, and good effects are observed in its use in arterial sclerosis. It is given in 10-drop doses, three times a day, for the entire preliminary period.

Old people do best if made to wait on themselves a reasonable amount of the time. Their interest in the daily paper should be stimulated and every effort made to get them into a cheerful frame of mind. This helps considerably to hasten convalescence and makes it more pleasant for all concerned.

Since a large percentage of major surgery is performed on patients past the prime of life, it would seem well worth while to employ every means to keep mortality statistics down and at the same time not to deny them the benefits which may be derived from operation unless there is some distinct contraindication. The field of successful surgery is rapidly enlarging in this class of cases.

NOTES AND COMMENTS

THE BULLETIN BECOMES A QUARTERLY

Beginning with this number, the BULLETIN will be issued quarterly in January, April, July, and October instead of monthly, as has been done since 1922. There will be only one volume a year.

It is a debatable question as to which form—quarterly or monthly—is preferable in order for the BULLETIN to accomplish the purpose for which it was established, namely, the giving of timely information to the Medical and Hospital Corps of the Navy. There can be no debate, however, as to the necessity of reducing the cost of publication at this time. In keeping with the general reduction of the appropriation for printing in the Navy, the amount allotted to the BULLETIN for the present fiscal year has been materially cut and, to keep within the allottment, it becomes necessary to reduce the number of issues. The Division of Planning and Publications and the editor of the BULLETIN regret the necessity, but realize that it is a real one.

If the number and quality of the articles received for publication justify it, the size of each number will be slightly increased, but no attempt will be made to enlarge at the expense of quality.

Contributors will please take note of the fact that, as the printing of the BULLETIN is done at the Government Printing Office, it is necessary for us to send our "copy" to press two months in advance of publication and that, as a result of this, it is possible that five months might elapse between the receipt of an article and its publication.

It is hoped that medical officers of the Navy will continue to support the BULLETIN as they have in the past. Its success or failure depends entirely upon the willingness of medical officers to devote a little of their time to writing upon some subject in which they are particularly interested or about some unusual case they have seen. The Navy Medical Corps is rapidly becoming a group of specialists whose opinions upon the subject in which they are specializing will be of great value to all the readers of the BULLETIN, within and without the Navy, and will be received as coming from experts. Give the benefit of your experience to others.

POSTGRADUATE INSTRUCTION

In the past it has been a not uncommon practice for officers of the Medical Corps, as well as other officers of the Navy, to attend courses of postgraduate instruction at the expense of the Government and, at the completion of the course, to resign from the service, thereby rendering the money spent for instruction and the salary paid to the officer while in attendance upon the course a total loss to the Government. It is only right that an officer given special courses should render some return therefor and not use the knowledge gained for his own benefit alone.

In order to put a stop to the practice of resigning upon completion of special courses of instruction the Bureau of Navigation has issued the self-explanatory letter which follows:

21 SEPTEMBER, 1925.

From: Bureau of Navigation.
To: All bureaus.
Subject: Postgraduate instruction.

1. Paragraph quoted from letter to all ships and stations:

"The department requires that officers applying for postgraduate instruction submit, with their application, signed agreements not to resign during the course and to serve three years in the naval service after completion of their postgraduate courses. Applications submitted by dispatch shall contain notation to the effect that this provision has been complied with."

2. The provisions of the above paragraph apply to officers of all corps requesting postgraduate instruction.

(Signed) W. R. SHOEMAKER.

BLOOD PRESSURE

J. A. MacWilliam, of the physiological laboratory of the University of Aberdeen, Scotland, has published in Physiological Reviews (V; No. 3, July, 1925), under the title "Blood Pressure in Man under Normal and Pathological Conditions," a most complete and thorough review of the literature of this subject as well as a report of his own studies along this line. The most important points brought out by the writer are given below.

Although accurate measurements of blood pressure in animals were made long ago, it was not until the armlet method was introduced by Riva Rocci that the estimation of the systolic pressure in man became practicable. The adoption of the standard breadth of the armlet or cuff was a most important step.

Oscillatory methods have now given way to the auscultatory method, which is vastly superior.

Experience has shown the importance of combining the tactile systolic index with the ausculatory index as a routine procedure. When correctly made, the latter should always show a higher value.

This checking guarantees the proper functioning of the auditory apparatus and guards against the error which sometimes arises as a result of repeated or prolonged armlet compression. Repeated readings are often necessary because of the excitement of the subject, and later readings are often considerably lower. As the author says, "Sometimes at a later stage of prolonged compression there is enfeeblement or disappearance (at variable points) of all the sounds below the upper region of sound, in the neighborhood of the systolic level. Such disturbances may occur while the actual blood pressure is not changed—as shown by the tactile systolic index remaining unaltered, * * *." Further, we are told that this source of error may be overcome by digital compression of the brachial artery for three minutes, thus removing the congestion of the limbs and the consequent abnormal resistance to obliteration of the pulse.

Quoting MacWilliam, "When the auscultatory method is rendered difficult by noisy surroundings or by impaired hearing in the observer, the vibratory method of Ehret * * * can be usefully combined—a finger being applied to the artery on the distal side of the auditory tambour to detect the vibration associated with the sound at the diastolic level. * * *"

Attention is called to the fact that the mercury manometer is the only reliable means of measuring pressures, and that if other forms of apparatus are used they must be checked against the mercury column at frequent intervals. The diastolic reading is often as much as 5 millimeters lower if taken during inflation of the armlet than when it is read during deflation. The difference in the readings of the systolic pressure by the auscultatory and tactile methods may be 5–14 millimeters.

Standards of blood pressure in healthy young adults have been arrived at by many observers. These do not all agree. Melvin and Murray, in 1914, working with 59 medical students from 20 to 29 years of age, found the average systolic pressure to be 112 millimeters. Only 3 were up to 130 and 5 were slightly below 100. The diastolic pressures were: Twenty-eight at 60–70 millimeters, 19 at 70–80 millimeters, and 12 at 50–60 millimeters. The pulse pressures gave an average of 46 millimeters. Other observers have generally given higher values. Alvarez, studying 6,000 men and 8,934 women, found the systolic pressure in men to group around 127 millimeters at 16 and 118 at 30, while in women it was 118 millimeters at 16, 111 at 24, and 117 at 40. Thus it is seen that there is a lowering of systolic pressure in early adult life. After 45 the average pressure in women is higher than in men. Faber has found that the pressure

varies considerably with the weight, the "overfat" averaging 123 millimeters, as compared with 117 millimeters for the "underfat."

With reference to the relation between blood pressure and age, MacWilliam says: "The available evidence shows that from the very early phase of life there is a progressive steady rise of pressure, apparently a function of increasing age, up to the onset of puberty, then an acceleration of the rise up to the ages of 17 to 20."

Among American boys, observers have found the rise between the ages of 5 and 14 to be about 15 millimeters, while among British boys this his been found to be 30 millimeters. During puberty and adolescence (13 to 17 years of age) the rise has been found to be 16 millimeters. Symonds, in a report on 150,419 men, divided his subjects into age groups, the youngest group being 15–19 years and the oldest 60 years and over. He found the average systolic pressure for the youngest group to be 121.2 millimeters and for the oldest 135.2 millimeters. Age, weight, and pressure were shown to increase together.

Stocks and Karns found "a positive correlation of systolic pressure with muscular strength apart from physical development and age." Their figures show only a small increase with advancing age—131 millimeters at 20 years to 134 millimeters in the group of 40 years and over.

That the high blood pressures of older people are not normal is stated by the author in these words: "It is warrantable to conclude from the concurrent evidence of the extended statistical evidence now available that the idea of an extensive progressive rise of systolic pressure in healthy persons as life goes on is an erroneous one. It is clear that the rising pressure of childhood undergoes acceleration about puberty and attains what is approximately the adult level somewhere in the 17 to 20 period. There is some evidence of a slight subsequent lowering—in the early years of adult life. Apart from this, the pressure remains almost steady till the age of about 40, after which a more definite rise progresses. But the rise, though quite a definite one, is more limited in amount than is commonly assumed; the total rise shown in the statistics, due to the combined influences of age and increasing weight, is on an average under 15 millimeters. * * * It is clear, in view of the foregoing averages, that the occurrence of exceptionally high pressures in healthy persons must be relatively rare, otherwise the averages would be much higher. * * *

Differences of 10 to 20 millimeters in blood-pressure readings can not be considered insignificant, but their importance varies with their position in the scale of pressures. Near the lower limits they mean more than if they occur at higher levels.

The 3:2:1 ratio of systolic, diastolic, and pulse pressures may be departed from rather widely without any abnormality being present. The ratio usually holds with certain normal pressures, e. g., 120–80–40. It does not hold good in the very low pressures sometimes found in healthy persons, e. g., 105–60–45. "Pulse pressures of deficient amounts associated with a high diastolic level are naturally of evil significance as indicating cardiac inefficiency, provided the low pulse pressure is not accounted for by an acceleration of the pulse rate."

The author shows that blood-pressure readings made after exercise do not show the actual height of pressure during the exercise. Readings made during the period of exertion show a rapid rise at first, then a slow decline, and a return to normal or even subnormal levels immediately after the exertion is completed. However, there is a subsequent rise in systolic pressure following this, although the maximum height of this rise bears no constant relationship to the maximum reached during exercise.

Ordinarily there is a fall in pressure during sleep, often amounting to 15 to 30 millimeters at the end of two hours' sleep. The diastolic pressure falls very little, if at all, so the pulse pressure is diminished. MacWilliam found that there are two entirely different conditions in sleep—1, sound sleep, in which the pressure is lowered, and 2, disturbed sleep, which may be attended by remarkable elevations of pressure. This may account for some of the deaths from cerebral hemorrhage which occur during sleep.

With reference to high blood pressure, the author says: "Notwithstanding the very large amount of attention that the subject has received, the causation and mechanism of persistently elevated blood pressure, whether in the form of simple or essential hypertension * * * or in association with kidney lesions, remain unexplained. While there is general agreement as to the existence of excessive pressures apart from any recognizable renal lesions and in the absence of any sign of functional inadequacy as tested by the modern methods for estimating renal efficiency, it is also clear from the evidence available that the significance of hypertension is greatly influenced by the coexistence of renal inadequacy, the latter giving a sinister aspect to the condition and seriously altering the prognosis. * * *"

Many observers have found that a high protein diet has no effect upon the pressure. On the other hand, H. J. Starling found in tuberculous cases, that an abundant meat diet brought about a definite elevation of pressure. Foster found that it took two months for a diet low in protein to produce a lowering of pressure.

The author suggests that some of the negative results reported with high and low protein diets might have been due to insufficient length of time of study.

Salt has been considered to have some relation to high blood pressure. Recent work fails to sustain this.

Cholestrin, urea, and the viscosity of the blood are evidently not causal factors in high pressure, according to the author.

"The search for pressor bodies of endocrine origin * * * as a cause of persistent high blood pressure has so far proved futile. * * *"

Guanidine is the latest pressor substance suggested and some evidence is offered to support the assertion that it may play a part in producing high blood pressure.

As to the relation of weight to blood pressure, MacWilliam says:

"The normal relation of blood pressure to the body weight in the healthy state has been shown to be a definite one, * * * increments of about 10 millimeters, etc., being found by Symonds in individuals of heavier build at all ages * * *. While this appreciable difference holds good in healthy persons, the effects of obesity are much more pronounced * * *. While greater degrees of obesity were associated with higher pressures, arteriosclerosis and chronic nephritis were not found to be the effective connection between obesity and high pressure. Apoplexy and sudden death are evidently related to the high pressures rather than the associations or effects of obesity acting in other ways. It is noteworthy, however, that Symonds states that fat elderly subjects in good condition and acceptable for insurance commonly have systolic pressures below 140 millimeters on an average."

Slowing of the pulse rate in inverse relation to the arterial pressure (Marey's law) "does not occur in the great majority of normal elevations of blood pressure * * *.

"A more warrantable statement * * * is that when the blood pressure in the head is raised by an increase of the peripheral resistance in the circulation or by local causes acting on the head (hydrostatic factor, etc.), such pressure tends to increase the controlling power of the vagus center, provided no other influence plays upon that center in the direction of reducing its activity—as occurs during motor effort, emotional stress, etc. * * *

"It is evident that if persistent high blood pressure is due, as is commonly assumed, to excessive peripheral resistance there must be some agency in action which counteracts the working of Marey's law, since, as is well known, the heart is not slowed even in the presence of exceedingly high arterial pressures. * * *

"As regards the direct relation of blood pressure to the normal functioning of the vasomotor center, Anrep and Starling have ob-

tained important evidence by a method of cross circulation. They caused the head of an animal to receive its whole blood supply from a heart-lung preparation while the body of the animal retained its normal blood supply from its own heart; this enabled them to study the direct effects of changes of blood pressure in the head on the medullary centers. They found that a rise of blood pressure in the head actively and almost immediately (after a latency measured in fractions of a second) depresses the activity of the vasomotor center, causing a fall of blood pressure in the body generally. Changes of pressure in the head induce reverse changes in the body; these are not transitory but last for a long time, generally till the pressure in the brain changes again. * * * It is obvious that a mechanism of this sort must militate strongly against the maintenance of an excessive pressure in the intact circulation.

"In view of many facts, it is clear that in persistent high pressure in man the condition is not simply one of increased vascular constriction, whether determined by undue activity of the vasomotor center or by chemical agents acting directly on the walls of the vessels. * * *

"It is evident that, whatever chemical agencies may be operative in other ways, in persistent high blood pressures there is a marked interference with regulating nervous mechanism, rendering them ineffective in keeping down the pressure to anything like the normal levels."

Whether or not high blood pressure may be an attempt on the part of the body to drive more blood through a vital organ that needs it is discussed by the author. The evidence adduced does not support the theory that high blood pressure is compensatory.

Although the mechanism of the fall of pressure in acute conditions, such as shock and cholera, is understood, the persistent low pressures which occur in exhausting diseases, or without known cause, have not been satisfactorily explained. Nor has the level at which pressures are to be considered abnormally low been definitely fixed. "Roughly, anything decidedly below 100 systolic or 60 diastolic may be suspected of being 'subnormal.' Some athletes in good training have such pressures as systolic 105 and diastolic 65."

It has been observed that for the mammalian heart an average pressure of at least 90 millimeters is necessary, otherwise the coronary circulation is apt to be insufficient. Low pressure after 50, with no organic lesion to account for it, is prognostic of a long life. Low pressure is not a reliable sign of early tuberculosis, but depends more on the severity than on the extent of the disease. Excessive smoking can lower blood pressure.

The author next discusses the capillary pressure and describes four methods for determining this: (1) Blanching methods; (2)

pressure required to cause obliteration of capillaries under the microscope; (3) pressure required to cause stasis of corpuscular flow under the miscroscope; and (4) piercing capillaries with a very fine capillary glass needle (containing saline at a measured pressure) under the microscope to measure the pressure in a capillary loop. Results obtained by these methods are too divergent (25 mm. H_2O to 70 mm. Hg) to be of value. Even if it were possible to measure this pressure accurately, it is questionable if it would be of value as so many extraneous factors enter. It is possible that there is a standard pressure in the capillaries of each individual. If this is persistently high, it may be of importance. Evidently there is no direct relationship between capillary pressure and arterial pressure. As to the relationship between capillary pressure and venous pressure, there are conflicting opinions, but it does seem to be close.

The question of peripheral resistance is next taken up and arguments for and against its being chiefly in the small arteries are advanced. In favor of this generally accepted view is the internal friction depending upon the rapid rate of flow in the arteries as compared with the relatively slow rate in the capillaries. Also the evidence shows that the loss of pressure in passing through the capillaries is relatively small, the greater loss having occurred before the capillary region is reached.

Stating the other side of the question the author says:

"On the other hand, if higher estimates of capillary pressure are correct, especially such as have been reported in some diseased conditions, with a large decline from capillary to venous pressure, it is evident that a considerable part of the peripheral resistance must be located in the region of the capillaries and venules. With regard to the possible influence of constriction of the venules, such might obviously have important effects."

Venous pressures have been found to be usually between 10 and 20 millimeters H_2O. They are liable to be much influenced by local conditions. It is doubtful if the study of venous pressure is of any value.

CANCER

In a recent number of the BULLETIN attention was called to the work done by Gye, in England, in searching for the cause of cancer. Much publicity has been given to Gye's announcement of his findings while very little has been said about Carrel's work along the same lines. This was carried out at the Rockefeller Institute.

An editorial in the Boston Medical and Surgical Journal (193; No. 13; September 24, 1925) gives a brief summary of Carrel's recently published papers which is of such interest that we are

taking the liberty of quoting from it to show of what Carrel's work consists and what his conclusions are.

"Employing the technique and knowledge acquired during the last 14 years in the study of tissue cultures Carrel found that when one adds a cell free filtrate from a Rous's chicken sarcoma to a pure tissue culture of monocytes from the blood the cells of this culture undergo certain retrograde changes, the surrounding coagulated plasma becomes liquefied and the cells or liquid of the culture acquire the property of producing sarcomas on injection into chickens. The same morphological changes were noticed in the migrating amœboid cells in cultures of other sarcomas and teratomas and similarly there was liquefaction of plasma. On the addition of cell free filtrates from 'tar' chicken sarcomas, which will be described later, to cultures of blood monocytes not only were these cultural changes noticed but in one instance in which the sarcoma was very malignant the cells and fluid of the culture became capable of causing malignancy on injection.

"It is well known that if bits of fresh embryonic tissue are grafted or fresh embryonic pulp is injected subcutaneously in a chicken a noninfiltrating, nonmalignant teratoma results. Bits of such a tumor transferred to another chicken give negative results. Carrel found that if small amounts of tar are injected intravenously into a chicken with such a tumor in some instances the tumor increases greatly in size, becomes infiltrating and on transfer is capable of causing tumors in other chickens. Such a tumor is called tar chicken sarcoma and is of the type mentioned in the preceding paragraph.

"On the basis of the above and other findings Carrel has concluded that two factors are necessary for the production of malignant tumors—(1) a focus of active cell multiplication and (2) a nonspecific chemical substance such as tar, arsenic, certain substances produced by bacteria or tissues injured by X rays, etc. When one of the latter, or a substance resulting from its action on the body tissues, finds itself in contact with body cells in process of active proliferation, the cells become 'sick' and manufacture a substance similar to the filterable agent of Rous's chicken sarcoma. He states it is possible that toxic substances in normal serum may act on the cells of an area of chronic inflammation in the same way that tar injected into the blood stream acts on a benign chicken teratoma."

According to the writer of the editorial: "The majority of pathologists have maintained that cell reproduction either in normal body growth and maintenance or following injury is ordinarily held in check by some unknown means. When this control is lacking, malignancy is very apt to result. Carrel's hypothesis fits in nicely

with this conception, much more so, in fact, than the theory recently advanced by Gye. It is easier to conceive of a tumor as arising from the action of a nonspecific chemical substance on an area of active cell proliferation rather than from the combined action of a specific chemical substance and a nonspecific living virus."

YATREN

P. H. Manson-Bahr and R. M. Morris, of the Hospital for Tropical Diseases, report in the Lancet (Vol. II, No. XI, 1925) the results obtained with yatren in the treatment of amebic dysentery. Their cases were only four in number, but their results were very striking.

Yatren ($C_9H_6O_4SNI$) was introduced by Mühlens and Menk in 1921. It is a combination of iodine with oxyquinoline-sulphonic acid with the addition of 20 per cent sodium bicarbonate, in which the iodine is so firmly combined that it is not driven off by boiling nor split off in the body, hence it can not produce iodism. When given by mouth or by enema it is rapidly absorbed and is, to a great extent, excreted in the urine.

The writers in their extensive experience found many cases of amebic dysentery in which, because of its nauseating and debilitating effects, the liability to emetine intoxication, the depressing after-effects, the necessarily very restricted diet required by its use, and the fact that in a certain number of chronic cases of amebic dysentery the organisms become resistant to the drug, it was useless to continue emetine treatment. In these cases yatren is very valuable.

Yatren may be given in pill form, each pill containing 0.25 gram and two being given twice daily; in cachets of 0.5 gram, twice daily; or by enema, 200 cubic centimeters containing 3 to 6 grams, daily for 8 to 14 days.

In the four cases treated by Manson-Bahr and Morris the results were entirely satisfactory in three and less so in the fourth. In the fourth case eradication of the infection was eventually brought about by the use of emetine bismuth iodide. Attention is called to the rapidity with which yatren acts in the acute stage of the disease, amebæ being apparently destroyed in four days after the injection of the drug by enema.

In the opinion of the writers, in order to get the best results, yatren must be given by enema as well as by mouth. The bowel must be previously washed out with 2 per cent sodium bicarbonate solution about 15 minutes before the injection of yatren, which must be given slowly by means of a funnel and tube. The solution should

be retained as long as possible (8 to 12 hours). Apparently no toxic effect is produced by the drug.

The conclusions arrived at by the authors follows: "Yatren is of definite therapeutic value in the treatment of amœbic dysentery. Our cases are limited in number, but were all typical examples of the disease. The results have been most gratifying and are apparently permanent. From the patient's point of view yatren therapy is more pleasant than any yet evolved, the toxic effect being almost negligible, and there being no necessity to restrict the patient's diet unduly. As the drug is not nauseating, our patients have been on a diet of fish, eggs, milk and milk puddings, and toast throughout their course of treatment."

DISINFECTION OF FRUITS AND VEGETABLES

Medical officers on duty in certain localities, particularly on the Asiatic Station, are frequently called upon to pass judgment upon the advisability of eating raw fruits and vegetables grown by the methods usually employed in these sections of the world. As a general rule, the answer is that it is unsafe unless certain precautions are taken. The precautions advised vary with the ideas of the individual medical officers. Some are useful but some are probably of no account. A standard method which can and will be used under all conditions is greatly to be desired. So far, none has been adopted by the Navy.

Ralph G. Mills, M. D., Clifford L. Bartlett, M. D., and John F. Kessel, Ph. D., of the Peking Union Medical College, have recently reported the results of some experiments along this line in the American Journal of Hygiene (5; No. 5, September, 1925).

"In regions where disease from infection of the alimentary tract are especially prevalent it is a common practice among foreigners to treat all fruits and vegetables which are to be eaten raw by one of the several methods considered in this paper. They are: 1, Chlorinated water; 2, potassium permanganate solution; 3, alcohol; 4, boiling water. Recently, solutions of iodine have been advocated, but this offers little advantage over the chlorin except the availability of tincture of iodine, which is found in every foreign household. Most of these methods have been found to kill the pathogenic bacteria, but the question of the viability of the cysts and eggs has remained a matter of dispute."

The experiments conducted by the writers of this paper ("The penetration of fruits and vegetables by bacteria and other particulate matter, and the resistance of bacteria, protozoan cysts, and helminth ova to common disinfection methods") were undertaken to

determine whether any uncooked vegetable or fruit is safe to eat, and, if so, under what conditions.

First, the attempt was made to determine if particulate matter, such as bacteria or cysts, could be drawn into the cut end of the vegetable or stem end of the fruit by transpiration currents. Of course, if this occurred, no form of external disinfection would be of much value. Ground lampblack in aqueous-eosin solution was used. It was found that, while the dye penetrated to the tips of the leaves of all fresh vegetables and to a slight extent into some of the fruits, the carbon did not penetrate at all. The conclusion drawn is that particulate matter, of the size of "bacteria, protozoan cysts, and helminth ova will not freely penetrate the substance of either fruits or vegetables, but remains on the surface or attached to those portions normally removed in preparation for table use."

Further experiments showed that "uninjured plant tissues, under market conditions, contain no bacteria of any kind." They also proved that organisms can live on the surface of fruits and vegetables for at least 15 days and that immersion of the fruit in chlorinated water of a strength of six parts per million for 15 minutes does not kill *B. coli*, while if the strength be increased to ten parts per million, the organisms are killed. Dropping fruit into boiling water for from 10 to 20 seconds killed all surface organisms except a few spore-bearing bacilli. Simple washing with soap and water and rinsing with sterile water reduces the number of organisms materially.

Working with protozoan cysts and helminth ova, one of the authors (Kessel) found that cysts of *Hartmannella hyalina* remain viable after immersion for 10 minutes in 2 per cent chlorinated water. (This is eight times the strength commonly used in treating fruit.) Eighty per cent alcohol and 3 per cent potassium permanganate failed to kill all cysts, while all cysts were killed by being submerged in boiling water for five seconds. Pouring boiling water over the fruit failed to kill all cysts, as did pouring alcohol on the fruit and then burning it off.

From the results of their experiments the authors recommend the following method of sterilizing fruit and vegetables as being safe:

1. Wash thoroughly in running water all articles intended to be eaten raw, in order to clear away clumps of bacteria, cysts, or ova that may be attached to the surface. Separate such vegetables as cabbage and lettuce, so that each leaf will be treated separately. Cut off all stem ends of vegetables and remove injured and decayed portions.

2. Submerge the fruits and vegetables in boiling water by means of a sieve or spoon for a period of 10 to 30 seconds. Use a vessel of boiling water of such size that the introduction of the food materials will not greatly reduce the temperature, at least not below 80° C.

3. Freshen in cold boiled water or in the refrigerator.

The authors conclude their paper with a summary which is quoted in full:

1. Normal uninjured fruits and vegetables do not contain living bacteria within their tissues.

2. Finely divided particulate matter, such as carbon, corresponding in size to bacteria, protozoan cysts, and helminth ova, does not penetrate the stem ends of fresh vegetables to any appreciable extent.

3. Bacteria do not penetrate the unbroken skin of fruits and vegetables kept under market conditions.

4. Bacteria, pathogenic to man, may gain entrance to fruits and vegetables through injured and decayed portions, where they may spread to a very limited extent, and may remain alive for 7 to 42 days. They may also contaminate the cut ends of vegetables and remain viable for a similar length of time. It is therefore advisable to remove such portions before attempting sterilization.

5. Pathogenic bacteria may persist on the surface of fruits and vegetables kept under moist conditions for 15 days or more. The gradual loss of moisture through the covering of fruits and vegetables would tend to keep them viable longer than would be possible on perfectly dry surfaces. When such foodstuffs are freshened with water the viability would be influenced by the saprophytic flora normal to such an environment.

6. Chlorination freed the surface of vegetable matter from pathogenic bacteria in every instance, but was not effective against cysts or ova.

7. Alcohol is ineffective in killing all protozoan cysts and helminth ova in sufficiently short periods of time to make it valuable as a disinfecting agent.

8. Potassium permanganate, in the concentrations ordinarily used, is not an effective disinfectant against helminth ova and protozoan cysts.

9. Burning alcohol on the surface of fruits and vegetables or pouring boiling water over them does not destroy all pathogenic organisms, either bacteria, cysts, or ova. The heat does not sufficiently penetrate the crevices.

10. Dipping fruits and vegetables for 10 seconds into boiling water or water which remains above 80° C. during the immersion is the only method thus far discovered which will uniformly kill all pathogenic bacteria, protozoan cysts, and helminth eggs which might be found contaminating such food products and render them safe for human consumption in an uncooked condition.

SPRUE

In Tropical Diseases Bulletin (22:9 (September), 1925) there appears the following abstract of an article by H. Harold Scott, entitled "The treatment of sprue." The original paper was published in the Lancet of March 21, 1925.

"Until recently sprue patients were advised against returning to the Tropics, but recent rational methods of treatment bring about a rapid and permanent cure if the case is taken in hand early. Under empirical methods, the author discusses the apparent value of the milk treatment and the strawberry cure, but he points out that fruit can only form a small part of the dietary. The administration of vaccines is, in some cases, attended by good results, but

the organism cultivated can not be the sole causative agent, since very different organisms produce apparently equal beneficial effects. Yellow santonin and emetine, which have been most extensively used in treatment, are uncertain.

"The calcium and parathyroid treatment is a rational one based upon laboratory tests. The fatty diarrhea, the cramps, the edema, and tetany are some of the symptoms attributable to faulty calcium metabolism. In sprue, but in no other spruelike conditions, the free or ionic calcium in the blood is reduced by 30 to 40 per cent. It is the regulation of calcium which is upset. By flooding the system with calcium this deficiency is temporarily made good and improvement ensues. This regulation of calcium is controlled by the parathyroid glands, so that when this extract is given twice daily in doses of one-tenth gram the symptoms of sprue clear up with marvelous rapidity. The stomatitis disappears in 10 days or so; the color returns to the feces in two to three weeks.

"The technique of estimating the ionic calcium is as follows:

"One and one-half to 2 cubic centimeters of blood in a serum tube is allowed to clot, yielding 1 cubic centimeter of serum, which is heated in a water bath to 56° C. for one hour. By adding fixed amounts of various dilutions of ammonium oxalate to 10 volumes of fresh normal serum the strength of oxalate which will just prevent clotting is found. By adding two volumes of various dilutions of calcium chloride the dilution just sufficient to bring about complete clotting of the blood is determined. By calculation the calcium content of the serum is estimated, which in normal persons is between 10.4 and 11.4 milligrams per 100 cubic centimeters. In severe sprue cases it is about 6.5 milligrams.

"Treatment consists of putting the patient to bed for the first 14 days, allowing milk only, beginning with 3½ to 4 pints daily and increasing by one-half pint in the 24 hours till 7 to 7½ pints are reached. Calcium lactate is given in cachets, containing 15 grains each, thrice daily and parathyroid extract, grain one-tenth twice daily, and it is absolutely essential that it should be free from thyroid extract. Constipation should be corrected with liquid paraffin. From the tenth day onward plain biscuits should be allowed, by which time the ionic calcium has increased to between 7 and 8 milligrams per cent. At the end of three weeks the average patient can take milk puddings, eggs, fish, potato, carrot, and bananas, and in the fourth week chicken and fruits. The calcium can be reduced in the third to fourth week and stopped at the end of the fourth. The parathyroid extract should be continued in full doses till the fifth week, then reduced until it is stopped altogether at the end of six weeks. This, however, can only be gauged with certainty by the blood test."

SKIN ANTISEPTICS

Everyone has had the distressing experience of having a clean surgical case develop skin or wound infection after operation. Then begins a search for some break in technique. Usually this is not found and the cause of the infection remains unknown. Seldom does the surgeon feel that the skin disinfection might not have been complete, as the method employed is always one that has been adopted after thorough trial and with which he is satisfied. That incomplete disinfection of the skin might well be the cause of many infections following operation is shown in an article, "The efficiency and inefficiency of certain skin antiseptics," by Drs. Martin B. Tinker and H. B. Sutton, which appeared in Annals of Surgery (LXXXII, No. 4, October, 1925).

In their paper the authors give the results of more than 1,200 laboratory tests made on a group of Cornell medical students and pupil nurses from the Ithaca City Hospital.

To determine the presence or absence of bacteria in the deeper layers of the skin of protected portions of the body, the skin of the inguinal and breast regions of 20 nurses was tested. Scrapings down to the true skin were transferred to agar slants and broth. Six of 22 cultures from the inguinal region and 4 of 21 cultures from the breast region showed no growth.

To test the efficacy of scrubbing with soap and water, areas of skin were smeared with *B. subtilis* and allowed to dry, after which they were scrubbed with gauze, soap, and water. Scrapings were then made and cultured. Thirty per cent remained sterile.

Next, preparation for operation, consisting of soap and water scrub, followed by ether, 95 per cent alcohol, mercuric chloride solution (1 to 1,000), and swabbing with ether on the operating table was made. Skin scrapings were taken and cultured in 58 instances. Seventy-five per cent showed no growth, but 25 per cent showed some growth, which, though slight, indicated a possibility of wound infection ever after such thorough preparation.

As it would be dangerous to smear virulent pathogenic organisms on the human skin, Tinker and Sutton used rubber gloves cut into strips in their experiments to determine the efficiency of various antiseptics against selected bacteria. The strips were dipped in the cultures, allowed to dry, and then dipped into the antiseptic solution being tested. It was found that with certain bacteria and certain solutions sterilization was complete, while with other bacteria or other antiseptics this was not the case. If bacteria are not killed on such a smooth surface with perfect contact with the antiseptic, it is unreasonable to expect sterilization to occur on the skin or in the tissues.

The antiseptics tested were: Alcoholic iodine, 5 per cent; benzine iodine, 5 per cent; picric acid, 5 per cent in 95 per cent alcohol; Harrington's solution; mercurochrome, 5 per cent in 50 per cent alcohol; acriflavine, 5 per cent in 50 per cent alcohol; acriviolet, 2 per cent in 50 per cent alcohol; and acriviolet, 1 per cent aqueous. These were used against *B. subtilis; Staph. albus; Staph. aureus; B. coli; Strep. hemolyticus; B. pyocyaneus; B. anthracis* (vegetative); *B. anthracis* (spores); *B. tetani;* and *B. aerogenes capsulatus.*

In the case of *Strep. hemolyticus*, when blood was present in the culture medium, only the dyes and picric acid were efficient. Some of the dyes kill spore-forming organisms in every case (acriflavine), while others failed to kill even *B. coli* (acriviolet). None killed anthrax spores, as was to be expected. The authors conclude that it is probably only by a combination of antiseptics that efficient skin disinfection can be attained. Thus far they have found only chlorinated lime paste effective against anthrax spores. Fortunately, these are not often present on the skin of patients.

The expense of the dyes militates against their general use, but, if care be used, one-half ounce of 5 per cent acriflavine solution will be sufficient to cover the average area needing preparation for operation.

Previous tests by the authors have shown Harrington's solution to be much more efficient than it was found to be in this series. (This is in keeping with the general opinion of Harrington's solution, which is known to be one of the best skin disinfectants available.)

Picric acid and iodine have the advantage of coloring the field so that its limits are clearly defined. The dyes also have this advantage and, recently, the authors have been adding a small amount of acid fuchsin to Harrington's solution to accomplish the same end.

The conclusions drawn by Tinker and Sutton as a result of their work are as follows:

"1. The superficial and deeper layers of the skin of protected areas in cleanly individuals are frequently free from bacteria.

"2. If the skin be smeared with resistant nonpathogenic bacteria, soap and water scrub alone for two minutes will make it free from bacteria in 30 per cent of cases.

"Careful ward preparation with ether swab on the operating table is capable of giving skin free from bacteria in 75 per cent of cases and of reducing the colonies in the remainder to a maximum of three.

"4. The selective action of antiseptics is so important that it seems wiser not to depend upon any single antiseptic for skin preparation.

"5. Iodine preparations, picric acid, and alcohol alone, which seem still to be the chief reliance in a number of hospitals, are too inefficient under ordinary clinical conditions to be depended upon for routine skin disinfection.'

"6. Acriflavin 5 per cent proved most efficient in this series of tests, but probably its use combined with other dyes and antiseptics might be desirable. The chief drawback to the use of the dyes is their almost prohibitive cost.

"7. It would probably be safer not to discard altogether the use of some of the older relatively efficient antiseptics until those used to supplant them have been given thorough clinical as well as laboratory tests in a number of hospitals."

VITAMINS

The following editorial, entitled "The artificial production of the antirachitic vitamin" appeared in the British Medical Journal of May 30, 1925:

"The discovery that irradiation with ultra-violet light causes the antirachitic factor to appear in substances which previously were inert represents a very important advance in medical science. In the first place, this discovery solves the mystery of rickets being cured by two such divergent specifics as sunlight and cod-liver oil; secondly, it promises to throw much light on the origin and nature of vitamins; and, thirdly, it renders possible the artificial production of at least one vitamin.

"As long ago as 1919 Huldschinsky proved that ultra-violet light could cure rickets, but for some years attention was diverted from this fact by another discovery, namely, that substances rich in fat-soluble vitamins acted as specifics in rickets. At first the antirachitic vitamin was believed to be identical with the growth-promoting vitamin A, but it is now believed that these two factors are distinct, although they are both fat-soluble and are usually associated. The prolonged controversy concerning the relative influence of bad housing conditions and faulty diet in the production of rickets was finally set at rest in a general agreement that rickets could be cured either by exposure to ultra-violet light or by administration of the antirachitic factor. The connection between these two specifics was, however, at first a complete mystery, but the problem has now been solved by work which has been conducted almost simultaneously in several laboratories, both in this country and in the United States of America.

"Steenbock and Hess both showed in 1924 that rats fed on a rachitic diet were benefited if their diet was exposed to ultra-violet light, and this explained previous work, which had suggested that rachitic rats gained not only by direct exposure to ultra-violet light but also if their environment alone was irradiated. Steenbock has since shown that a large number of foodstuffs, but not all, can be activated by exposure to ultra-violet light. Drummond and other

workers in this country had meanwhile brought forward evidence indicating that the active antirachitic substance in cod-liver oil was closely associated with cholesterol. Steenbock, Drummond, and Hess have all since shown that solutions of chemically pure cholesterol, which have no antirachitic action, acquire this property after exposure to ultra-violet light. The antirachitic factor can, therefore, be produced from a pure chemical substance by the action of ultra-violet light. This result is remarkable and unexpected, for Zilna in 1920 had shown that prolonged exposure to ultra-violet light actually destroyed the vitamins in cod-liver oil. The nature of the change produced by the ultra-violet light is unknown, but it would appear that it is of a chemical nature, that only a minute fraction of the cholesterol acted upon is activated, and that this fraction is destroyed by prolonged exposure. It is certain that other substances besides cholesterol can be activated, and these substances are probably sterols related to cholesterol.

"This discovery should have immediate and important practical results, since it makes it possible to confer antirachitic properties on a large number of foodstuffs. In particular it appears to be possible to render vegetable oils antirachitic. Further, it is to be noted that experiments have already shown that rickets can be treated successfully with irradiated milk. The antirachitic factor is relatively stable, and it seems probable that means will be discovered for producing the factor in a concentrated form. The discovery should, therefore, render the prevention of rickets a comparatively cheap and simple matter.

"Steenbock suggests that the antirachitic factor may also prove beneficial in other diseases where the calcium metabolism is deranged, and in diseases such as infantile tuberculosis, where sunlight and ultra-violet light have already been proved to have beneficial effects. The discovery that the antirachitic factor can be produced from the sterols gives us reasonable grounds for hoping that before long its chemical nature will be elucidated and that means of isolation and concentration will be found. The other fat-soluble vitamins which produce growth and reproduction appear not to be produced by irradiation, but the discovery of a means for the production of one vitamin naturally encourages the hope that before long similar discoveries will be made in the case of the other vitamins."

CULTURING AMEBAE

The damage caused by *Entameba histolytica* in tropical and subtropical countries is so enormous that any advance in knowledge concerning that organism is a matter of great importance. Such an

advance seems to have been made by Drbohlav and Boeck, who have succeeded in cultivating *E. histolytica* on simple media and have thus been able to follow the life cycle of the parasite more closely than has hitherto been possible.

Drbohlav and Boeck have published the results of their work in various scientific journals. A summary, with comments, of the several published articles appeared in Tropical Disease Bulletin (22:9 (September), 1925). The following is an abstract of that summary.

Although the work of Drbohlav and Boeck was done in 1924 and the results reported before the Royal Society of Tropical Medicine and Hygiene, the Société de Pathologie Exotique, and the National Academy of Science in that year and in the early part of 1925, publication of a full report of their experiments was not made until July, 1925, when it appeared in the American Journal of Hygiene.

The original cultures with which Boeck and Drbohlav worked were obtained accidentally while they were experimenting with a medium devised by Boeck for the cultivation of intestinal flagellates. After modifying this medium and trying others, they finally adopted a medium which is half solid and half liquid. The solid is in the form of the ordinary test-tube slant and the liquid covers this. The former may be coagulated whole egg, or Dorset's egg medium, or ordinary blood-agar. The liquid may consist of inactivated serum (horse or human) diluted with Locke's solution (1:8), or egg albumin diluted with Locke's or Ringer's solution (1 per cent crystallized egg albumin or the whole of one egg to the liter). The solid is sterilized in the autoclave, after tubing, and the liquid by filtration through a Berkefeld filter. The reaction of the media must be between pH=7.2 and pH=7.8.

By means of a capillary pipette, material from stools containing active forms of *E. histolytica* is inoculated into the tubes, which have been warmed to 37° C. It is placed at the bottom of the liquid, as the greatest growth occurs at the interface between the solid and liquid. The cultures are then incubated aerobically at 37° C.

The maximum growth of amebæ is usually seen on the second day of incubation. After this they diminish in number and usually die out on the fifth or sixth day. Subcultures must be made every second, third, or fourth day if it is desired to preserve the strain.

Cultures of *E. histolytica* made in this way are never pure. The medium is suitable for the growth of other amebæ and some other intestinal parasites. *Blastocystis* grows so well upon it that it may overgrow the ameba and prevent its cultivation. *Entameba coli*

lived for three days in the initial culture, but Boeck and Drbohlav were unable to obtain subcultures of this species.

It is interesting to note that *E. histolytica*, when cultivated by the methods described, feeds upon bacteria instead of upon living tissues. It adopts the food habits of *E. coli*, which makes it possible for it to live in this medium. However, when red blood cells are added to the medium the amebæ ingest them.

The authors isolated and cultivated two strains of *E. histolytica* from the stools of two patients with typical amebic dysentery. The first strain was kept going through 152 subcultures and the second through 47 subcultures. Both were accidentally lost. The amebæ remained morphologically identical with those in the patient's stools and retained their infectivity for kittens. The infections produced in kittens by intrarectal inoculation were readily transmitted to other kittens and from these the amebæ were repeatedly recovered in culture.

In only one strain was encystation observed and in this only six cysts were found. The addition of skatol to the cultures did not cause the amebæ to encyst, nor did placing them in the ice box do so.

The summary from which this abstract is made concludes as follows:

"There can be no doubt that these papers * * * constitute a notable advance in the study of intestinal amebæ. Previous workers may possibly have succeeded in cultivating *E. histolytica*, but the discovery of the simple and certain methods here described has, for the first time, opened up many possible lines of research which appeared hitherto unattemptable. The methods described are not perfect, and much still remains to be done for their improvement, but it is beyond dispute that the work of Boeck and Drbohlav has already attained a stage from which immediate further advancement of our knowledge of the intestinal amebæ is assured."

X-RAY TREATMENT OF CALLOSITAS AND VERRUCA PLANTARIS

The Journal of Bone and Joint Surgery (VII, No. 4, October, 1925) publishes an article entitled "The X-ray treatment of callositas and verruca plantaris, with some remarks on the pathogenesis of these lesions," by Drs. L. K. McCafferty and C. Lee McCarthy, in which these annoying lesions are clearly differentiated and methods insuring their painless and quick removal are given.

(It will be recalled that in the BULLETIN for August, 1925, Lieut. (Junior Grade) J. Markey (M. C.), United States Navy, described an excellent treatment for these conditions when X ray is not available.)

The authors state that verruca plantaris, or papilloma, is probably due to a filterable virus and that, when the virus is inoculated into the skin, we get an inflammatory reaction which results in the rete pegs growing downward and the papillary bodies growing upward. At the summit of each papillary body are capillaries which, when cut, give the pin-point bleeding so characteristic of warts. Removal of the warts by the knife results in profuse bleeding and there is always the danger of autoinoculation.

A callus is simply a hypertrophy of the horny layer over a circumscribed area which has been subjected to pressure or irritation.

In spite of the differences between callus and verruca plantaris, the two are often confused. The plantar wart is a papilloma, but a papilloma is never a callus. Frequently the two occur together.

X-ray treatment will result in the cure of either lesion, but the response of the conditions to the rays will differ somewhat. Before X rays are used in treating callus attempt should be made to relieve pressure on the part affected. Sometimes this will result in cure, but often it will not. Then X ray may be used with an assurance of success.

The technique of the treatment of callus is as follows: No caustics nor keratolytics for two weeks prior to beginning X-ray treatment. Trim the callus as thinly as possible. Shield the surrounding skin from the rays. The initial treatment should be 1½ skin units, unfiltered. The second dosage may be the same as the first. The third and fourth treatments, if needed, may be the same as the first two or the dosage may be reduced to 1¼ skin units, if the callus shows marked signs of involution, or, if the callus has not changed, it may be increased to 1¾ or 2 skin units, unfiltered. If the callus has not responded by the end of the fourth month, X-ray treatment should be discontinued. Almost without exception four treatments will result in cure. When failure occurs it is probably because the full inhibitory dosage has not reached the basal layer.

With verruca plantaris, one or two treatments will often suffice. The initial dose should be 1¼ skin units, unfiltered. The second, one month later, should be the same. Usually, the pain will abruptly disappear. Frequently after one or two treatments the wart may be picked out. This should always be attempted, as, if successful, it ends the treatment.

If callus and wart occur together, three or four treatments are often necessary and rarely failure results.

Other methods of removing warts and callosities are frequently successful but are often so painful that the patient will not return for treatment. Therefore, when X ray is available, it is the method of choice in treating these conditions.

THE CORAL SNAKE

Much uncertainty exists in the minds of many persons as to whether or not the coral snake is capable of biting a human being and, if so, whether or not its bite is seriously poisonous. In view of this uncertainty, it is interesting to read a short article by E. R. Dunn, of Smith College, which was published in Science (LXII, No. 1605, October 2, 1925). Part of the article is quoted:

"In Newman's recent 'Vertebrate Zoology," on page 257, there is the following statement: 'The coral snakes are said to be extremely poisonous, but their biting apparatus is so constructed that they can not open the mouth wide enough to bite a human being, so that they may be set aside as harmless, so far as man is concerned.'

"The facts are as follows: Even new born snakes can open their mouths wide enough to bite a man's finger, and the theory that a grown coral snake can not bite a man is *a priori* ridiculous, even setting aside recorded instances of their so doing. Willson (Archives Int. Med., 1908, 1, p. 516) has collected records of 740 cases of snake bite in the United States. The harmless coral snake, unable to bite a human being actually bit 8 human beings, of whom 6 died, making a mortality of 75 per cent, as against 408 cases of rattlesnake bite, of whom 48 died, a mortality of under 12 per cent. The coral snake is, therefore, six times as deadly as a rattlesnake, and, while they seldom bite people, on account of small size and secretive nature, yet they are potentially the most deadly animals in the Americas."

NURSE CORPS

Miss Ada E. Griffiths, nurse, United States Navy, and Miss Matilda E. Anderson, reserve nurse, United States Navy, attended the International Council of Nurses held at Helsingfors, Finland, in July, 1925. The reports on the council from these nurses of things seen and heard are so different that they are both printed in full, with almost no repetition of facts.

THE INTERNATIONAL COUNCIL OF NURSES

By MATILDA E. ANDERSON, Reserve Nurse, United States Navy

The International Council of Nurses held its sixth regular meeting at Helsingfors, Finland, in July, 1925. During a three months' leave of absence which I spent in Sweden, my native country, I was fortunate to have an opportunity to attend the convention in "duty status."

The time required to travel from Stockholm to Helsingfors by boat across the Baltic Sea is 23 hours. I decided to leave Stockholm on the 15th of July and the congress began on the 20th. On the day I left I learned that 44 more nurses were listed for the same ship, 40 of whom were from Canada. The first morning on board the steamer I was able to make myself useful as an interpreter, as the entire personnel spoke Swedish, so then and there my "duty status" began. I made the reservations in the dining room, each passenger having place cards colored according to sittings, first, second, and third. Then came the usual passport inspection and filling out of certain blanks. The day passed all too quickly; we enjoyed every moment of the trip; the weather was ideal and the sea like a mirror. We passed the most wonderful archipelago on the southwest coast of Finland. All that could be seen was an endless ocean of rocks, and in many places the straits were so narrow that one could throw a stone from either side of the ship to the rocks on the shore. An officer told me that boats never met in that part of the Baltic Sea. There are daily connections between Stockholm and Abo, a city farther north, and practically all open sea.

Helsingfors is a city of about 200,000 people and 90 per cent of them speak Swedish. We arrived there at 7 p. m. and were met at the pier by the committee on lodgings, composed of 10 Finnish nurses, who gave us a royal welcome. They assisted us in every

way, even insisting upon carrying our heavy bags. We were excused from customs inspection upon presenting our cards of admission. Within an hour we were all in comfortable hotels conveniently located to the meeting places. Hotel rates were very reasonable, 30 to 45 marks, from $1 to $1.25 per day. Baths were extra. About 20 nurses were assigned to each hotel. I learned later that the majority of the Scandinavian nurses were lodged in nurses' homes and private families. Lunch and dinner had been arranged for at the Student Club; breakfast was served at the hotel. The meals were excellent and very reasonable, lunch 13 marks and dinner 15, or from 50 to 60 cents.

The next day most of us made our return reservations, as we could see that there would be crowds. Groups of nurses arrived several times a day, either by train from Abo or by boat from all directions. The committee on lodgings asked me to go with them to meet incoming boats and trains. The high schools in Finland teach French and German more than English, so anyone speaking Swedish and English was in great demand. I met another Scandinavian nurse from Milwaukee who acted as interpreter also. At the pier was a retired Swedish sea captain who could speak four languages fluently. He was a most valuable bureau of information.

On Monday the greatest number of nurses arrived, three boats from Sweden, one from England, one from Germany, and a great many by train from Abo. A great number of American nurses came across the Atlantic on the S. S. *Caronia* to England, by boat from there to Norway, and by rail to Stockholm, or by boat from England to Gothenburg, Sweden, and canal trip to Stockholm. The time before the convention opened was well spent in seeing the city and its suburbs. I was official guide, and I assure you I did not miss anything. Taxi rates were ridiculously low, 10 marks being the usual fare to almost any part of the city.

Two hundred and three nurses came from the United States and 55 from Canada. Nurses from Australia and New Zealand had a nice six weeks' voyage via Africa, the Mediterranean, and Gibraltar. Japan sent two nurses; they told me they had traveled 11 days on the trans-Siberian railroad. Six nurses came from China, of whom five were missionaries. Finland had about 500 nurses taking part in the convention. According to size of population and geographic location, Russia had the smallest number of representatives, as only two nurses came. I was informed that they had difficulty in obtaining passport visa. Owing to Bolshevic propaganda, the Finnish Government was obliged to take every precaution, having learned by experience that the most dangerous leaders are among women. In all, 1,100 foreign nurses came to Finland. I saw only

three Mongolian nurses, one from China and two from Japan. Asia and Africa had many representatives, but they were all white.

Nurses who came from warm climates were under the impression that Finland was very cold, and they were equipped as if for an expedition to the North Pole. They brought heavy suits and fur coats, and, to their surprise, the temperature was about 100 in the shade from six to eight hours a day. The nights were comfortable and cool, sometimes even chilly. In Helsingfors, as in the cities of the Scandinavian countries, there are no street lights during June and July.

Nurses' street uniforms were of a great variety. Finnish nurses wore dark blue suits and blue bonnets, with a veil flowing down behind. Finnish-Swedish nurses wore gray tailored suits, with a blue bonnet and veil. They also wore numerous badges to indicate the committees to which they had been assigned. Danish and Norwegian nurses wore black regulation suits, with bonnet and veil. Swedish nurses wore black bonnets, without the veil but with a chin strap with a cute little bow on the left side. All Scandinavian nurses who are enrolled in the Red Cross wear the brassard on the coat sleeve. German and Austrian nurses wore black bonnets large enough to cover entirely the hair, with veil attached. Belgian nurses wore bluish gray suits, with hat to match, a badge on each shoulder and on the front of the hat. French nurses had very attractive suits and hats and some wore service medals. Nurses from English-speaking countries did not wear outdoor uniforms.

July 18 was registration day. The fee was 50 marks. We were given folders containing all information needed, maps of the city, invitation cards to social entertainments, a badge with I. C. N. in blue on white enamel, and a brassard with the initials in blue on white ground and the name of the country the wearer represented. Headquarters were in a building called Standerhuset, the same as our city hall or congressional building. For general sessions we had at our disposal the Finnish National Theater, which seats about 1,500.

Sunday, July 19, from 12 to 2 p. m., we attended a moving-picture theater where pictures were shown of the Grankulla Children's Home, the care and discipline of infants and young children, preparation of formulas, etc., the nurses' home and their recreations. Then followed pictures of sport and industry, and scenery of the land of a thousand lakes and waterfalls. After the show we divided into two groups, one for the National Museum and one for the Art Gallery.

July 20, from 3 to 4 p. m., the Graduate Nurses' Association of Helsingfors gave a tea in a fashionable park restaurant. From 4 to 5 p. m. a musical entertainment by a Finnish composer, Sebelius,

was given at Nickolai Church in honor of the congress. The choir was composed of 200 graduate nurses. At 8.30 p. m. the congress opened, Baroness Mannerheim presiding. Addresses of welcome were given by Dr. Leo Ehrnrooth, chairman of the Town Council of Helsingfors, and by representatives of the Medical Board of Finland. Greetings were read from several prominent leaders of national organizations. Meetings, with a few exceptions, were conducted in the English language. Usually there was one general session in the morning and two in the afternoon and evening, often lasting as late as 11.30 p. m. The subjects were so many and so interesting it seems almost impossible to describe even a fraction. Hospital management and public-health nursing were frequent topics. We had the pleasure of attending a very interesting lecture on infant welfare given by a nurse from New Zealand. She emphasized the use of mother's milk for infants, both as a preventive and a curative in disease. She also gave a brief talk on sanitation in stamping out tuberculosis in man as well as in animals, giving a number of statistical reports on the remarkable results obtained. Methods used were demonstrated by slides.

A report was made on the difficulty of nursing in India, both hospital and public health, owing to religious superstition among the natives. A heartbreaking story was told of the inhuman cruelty practiced on obstetric patients. A nurse from China told a rather amusing story. Her hospital wanted to open a modern welfare clinic. The physician in charge appealed to the mayor of the city for permission to do so, and explained the reduced mortality among infants, their increased resistance against disease, the benefits to be derived for mothers and babies, and gave a number of reports of results obtained. The Chinaman listened in patience until his chance came to express an opinion, when he said: "It is a very foolish suggestion to try to save more babies when we are unable to provide for those we already have."

Round tables, with one exception, were between 9 and 10 a. m., and the most interesting subjects were chosen. Nursing under Government auspices and the organization of nursing under the Red Cross interested many. Denmark, for example, has only 50 nurses enrolled with the Red Cross, but they have a reserve force of 2,000 in an inactive status who are under the same obligation to the army nurse corps as the National Guard to the Regular Army in the United States. In Norway and Sweden the Red Cross conducts a training school for nurses, the pupils affiliate with military and various civil hospitals, spending 6 months in the former and from 18 to 24 months in the latter. After graduation the nurses are subject to call for any national emergency or disaster. The Red Cross

enrolls, also, graduate nurses from recognized training schools in the United States. They have a directory where enrolled nurses as well as their graduates may apply for positions. In Sweden tuberculosis district nursing is entirely cared for by the Red Cross.

Tuesday, July 21, from 5 to 7 p. m., the consuls entertained the nurses from their respective countries. Wednesday, July 22, we had luncheon at the park restaurant. We were classified according to the branch of nursing in which engaged. At my table were seated 36 army and navy nurses from all over the world. To my right was a Swedish Army nurse and to my left a Finnish Navy nurse. We did not observe the good old rule, "No shop talked at table," but each nurse told her neighbor how the army or navy nurse corps should be run, using her own corps as a criterion. At 3 p. m. we assembled in the town square for an auto ride of 3 miles to a place called Folison, where we were given a lovely garden party. We were shown homes centuries old and museums and churches erected in 1648. From 6 to 8 p. m. we were entertained by the Brage Society, a group of professional folk dancers. About 50 of us lined up and some excellent snapshots were obtained. We returned by boat to the city at 9 p. m.

On July 23 the Finnish Red Cross gave a reception from 9 p. m. to midnight to about 200 nurses who were or had been connected with the Red Cross Nursing Service. We were taken by special street cars to Brando, 5 miles from the city, and returned by boat at midnight. It was as light as midday.

On July 24, Friday, all of the hospitals gave luncheons. My card read Tillka Army Hospital, so I proceeded with many others to a beautifully located hospital, 150-bed capacity, about 6 miles out in the country. It was formerly a civilian hospital but had been taken over by the Government. A four-course luncheon was served under the birch trees, while a military band played many inspiring airs. Shortly after lunch we returned through the city to South Harbor, where we took boats to the Sveabarg fortifications, a group of rocky islands. We visited the hospital and grounds, then attended a coffee party in the garden near the nurses' quarters. We returned at 5.30 p. m., in time to attend the closing meeting of the council. All social entertainments were well planned so as not to interfere with business meetings.

Boat rides were planned for Saturday, the 26th. The boat went around the Sveabarg Islands, where we landed and were met by a choir of graduate nurses who sang for us. Then we had a lawn picnic lunch, were shown many historic places, and taken through underground tunnels built in the seventeenth century. We returned by boat. At 8 p. m. a farewell banquet was given for representa-

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tives from five continents and attended by 500 nurses. After dinner reports were read and speeches made. The most notable speaker was a Mrs. Strong, from England. She was 84 years old and had a daughter and granddaughter, both graduate nurses, with her at the convention. Baroness Mannerheim was presented with a gorgeous string of beads from the Chinese Red Cross nurses. She announced that the next International Council of Nurses would be held in Peking, China, in 1929. The charming Miss Lillian Wu, superintendent of nurses at the Red Cross Hospital, Shanghai, China, extended a hearty invitation to us all to attend. The bell rang and the Nurses' Congress closed. The following morning about 50 of us departed by boat for Stockholm. Our ever-faithful sister nurses, a group of 20, came to see us off.

THE INTERNATIONAL COUNCIL OF NURSES

By Ada E. Griffiths, Nurse, United States Navy

The International Council of Nurses, founded in London in 1899, held its sixth congress July 20 to 25, 1925, at Helsingfors, a seaport and the capital of Finland.

Upon my arrival there I was met by an English-speaking nurse who took full charge of me, my baggage being quickly stamped by customs. We rode into town in a horse cab, stopping for a hurried lunch at the Students' Club, then by taxi to the Military Medical Hospital, where I was to live in the nurses' quarters with other government nurses who had arrived earlier. This hospital was 2 miles out of town, a short walk from the car line and through an avenue of pines. In my pleasant room was a window box of large purple petunias, very fragrant in the cool of the evening. I enjoyed the quiet here after the long trip on three different boats and trains to reach this "Land of the Midnight Sun." The season of the midnight sun was passed, but the evenings were almost as light as day. The Scandinavian and Finnish people call this the "crown year," meaning good crops. They spend as much time as possible out of doors during their short summer.

All visiting nurses registered at the headquarters in the statehouse, which was a busy place. We were given our portfolio containing the program of the sessions, our brassard of white with lettering in blue, I. C. N., and the country one represented, mine being United States of America. This was our introduction to others. Our badge was a pin of blue and white with silver-colored letters, I. C. N., the same design being used on the back drop curtain on the stage of the National Theater, where the sessions were held. An upper box

was decorated and reserved for the President of the Republic, but I believe he was unable to attend.

The program started Monday afternoon with a musical service in the Church of St. Nicholas. A new composition by a Finnish composer, Sibelius, was given in honor of the congress. At the National Theater the evening session was most enjoyable. The band sat at the back of the stage, played a few numbers and accompanied a mixed choir. The address of welcome was given by Dr. Leo Ehrnrooth, chairman of the town council, and the response by Baroness Sophie Mannerheim, the president of the International Council of Nurses. An address of greeting from the International Council of Women and from the International Woman Suffrage Alliance was read by Annie Furuhjelm, late member of the Finnish Parliament. Ethel Gordon Fenwick, founder of the I. C. N., was the last speaker of the evening and spoke on "The trained nurses' part in peace."

On Tuesday the address of welcome was by President Mannerheim. Then the roll call, the greatest number responding from Finland, with the United States second. Reports were read from 26 affiliated and nonaffiliated countries. In the afternoon we called at our respective legations at invitations from their representatives. We have six men in the office of the chargé d'affaires of the United States of America. They served us delicious cakes and tea or coffee. They seemed to enjoy meeting us, as they do not often see people from home. These men are all married and, with their families, agree in liking Finland except for the long winter. In the evening a lecture and demonstration with lantern slides on Sir Frederick Truby King's methods of child welfare work was given by Jennie B. N. Patterson, who represented this department from New Zealand. It was especially interesting, showing disease in animals and plants as well as in babies and children, and how they can be cured. She also spoke of prevention of disease if they can get their methods started early and give the babies the same care and chance that is given to prize cattle and plants in order to bring them to perfection. Proper elimination was especially stressed. It is claimed that New Zealand has the lowest death rate from infantile diarrhea in the world.

A special luncheon had been planned for Wednesday at the Restaurant Kapellet on the Esplanade near the harbor. Tables were set on the veranda and in the garden, where the military band plays at noon and in the evening. We had been asked to "sign up" for this group luncheon previously, each in her special branch—public health, special nursing, military, and so on—this giving us greater opportunity to get acquainted with each other. At 3 p. m. we were driven out to a garden party. We followed our nurse

guide through a large pine forest, viewing the rustic attractions along the way and stopping at the pavilion for refreshments that had been provided for us, then strolling on again to a grassy slope to rest and watch an entertainment staged in our honor given by men and women in national costume. One couple was dressed in wedding finery. A Maypole had been decorated and erected for the occasion. A boat ride back to town ended a very pleasant afternoon.

Round tables, at which discussions were conducted on many nursing subjects, were usually scheduled for 9 to 10.15 o'clock in the morning. On the second floor at headquarters were exhibits on nursing sent by many of the affiliated countries, each arranged separately. The Finnish exhibit occupied a third of the space and we were especially interested in it. One could be served with ices and cakes and hot and cold drinks at headquarters in the garden, also on the upper floor of the theater. President Mannerheim said there would be tea for the English, coffee for the Scandinavians, and ice cream for the Americans.

At the Thursday session, General Mannerheim, speaking in French, represented the Finnish Red Cross and the League of Child Welfare. He was followed by the secretary of the league, who told how actively interested General Mannerheim is in this work. A map in their office shows the large areas they have covered organizing branches for public health in Finland, and in a comparatively short time. Dr. René Sand, secretary general of the League of Red Cross Societies, told us of the activities of the Red Cross in Europe. He was well informed and an interesting speaker. He gave a cordial invitation to all who expected to visit London or Paris after the congress to call at the Red Cross headquarters.

Later we went, in special cars marked with a red cross, to the Casino de Brando on an island. There we were received by Baroness Mannerheim and her brother, General Mannerheim. The buffet refreshments were delicious. We found our chairs on the roofless veranda and listened to excellent orchestral music, then returned to town by launch with the lights all turned out, as it was still light.

Friday was the last day of the sessions, one feature being lantern slides from different countries on nursing subjects. There were some old pictures showing the progress that had been made, also some moving pictures taken in Helsingfors. The band played again for the closing and the chorus of young graduate nurses, who had sung to us before, concluded the program by singing the Finnish national anthem. These nurses wore white uniforms, their cap strings tied under the left side of the chin, and were very pleasing to look at with their healthy natural complexions.

The nurses on the various committees wore their street uniforms, one group dark blue, the other medium gray buttoned high at the

neck. They gave a very military appearance. Their hats were small and of dark blue velour with plaited veils hanging halfway to the waist line in the back. The majority of those in uniform spoke English. All were very hospitable and always ready to help and direct us. Nearly all the papers were given in English.

The food was very good and plentiful, at a moderately low price.

The Finnish Association of Nurses has about 1,000 members, and is one of the most interesting, as it has had from the beginning as its most important aim the education of the nurse. Their attitude seems to be service and helping others, making one proud to be numbered in the nursing profession.

We learned that Finland was the first country in Europe to have woman's suffrage, and declared itself a Republic in 1917. Women greatly outnumber the men and are engaged in many branches of work.

We all agreed we would like to return some time to visit again this beautiful lake country. The convention brought us in closer touch with the nurses prominent in present nursing history and was most interesting and inspiring.

BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,
United States Naval Medical Bulletin,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.
(For review.)

Modern Medicine, Edited by *Sir William Osler, Bart., M. D., F. R. S.* Third edition, thoroughly revised. Re-edited by *Thomas McCrae, M. D., Professor of Medicine in the Jefferson Medical College; Fellow of the Royal College of Physicians, London; etc.*, assisted by *Elmer H. Funk, M. D., Assistant Professor of Medicine, Jefferson Medical College.* Volume I. Lea and Febiger **Philadelphia, 1925.**

Twelve years ago the second edition of the first volume of Osler appeared. Now comes the third edition, an unusual event in connection with a system of medicine. In the meantime, the illustrious editor has died, but his work still lives. Progress in medicine continues and necessitates revision of medical writings from time to time, no matter how carefully written or how up to date such writings may have been at the time of publication. Advances in the knowledge of new diseases, in the pathology and treatment of old diseases, and in methods of diagnosis, made since the second edition of Osler appeared, have caused Doctor McCrae to revise and re-edit this volume. Because of his former close association with Osler and his own high standing in the profession, no one could be better qualified than he to undertake such a work. That he has made a success of it goes without saying.

Volume I deals with bacterial diseases and the nonbacterial infections—the mycoses, and contains the valuable chapter by Ludvig Hektoen, "Introduction to the study of infectious diseases." Of special interest are the chapters on tuberculosis by Baldwin, Krause, and Brown which, taken together, give a complete survey of all the facts concerning this disease.

The thousands of medical men who have become accustomed to referring to Osler's system whenever confronted with difficult problems in medicine will do well to obtain this new edition as soon as possible, with the assurance that therein they will find the answer to their problem presented in such a way that it may be used to advantage.

THE SURGERY OF PULMONARY TUBERCULOSIS, by *John Alexander, B. S., M. A., M. D., Assistant Professor of Surgery in the Medical School, University of Michigan; Formerly Assistant to the Professor of Clinical Surgery, University of Pennsylvania; Member American Association for Thoracic Surgery, etc.* With introductions by *Hugh Cabot, M. D., C. M. G., LL. D., F. A. C. S., Professor of Surgery and Dean of the Medical School, University of Michigan, and Edward R. Baldwin, M. A., M. D., Director of the Trudeau Foundation and Trudeau School of Tuberculosis and of the Saranac Laboratory for the Study of Tuberculosis.* (This monograph has been awarded the 1925 quinquennial Samuel D. Gross Prize by the Philadelphia Academy of Surgery). Lea and Febiger, Philadelphia, 1925.

When Doctor Alexander's articles on this subject first appeared in the American Journal of the Medical Sciences the reviewer was so impressed by their unusual character that he wrote to the author, recommending that they be issued in book form, so as to be avaliable for teaching purposes. So it is an especial pleasure to welcome the appearance of this volume.

Doctor Cabot, in his introduction, writing from the surgeon's point of view, calls attention to the fact that little progress in this field has been made by American surgeons. He expresses the hope that this book will give great impetus to the surgery of the tuberculous lung.

Doctor Baldwin, writing as a phthisiotherapist, reminds us that sanatorium treatment has had at best a 10 per cent recovery rate for the far advanced pulmonary invalid. The tuberculosis specialist must acquaint himself with the demonstrated value of phrenicotomy, thoracoplasty, and pneumolysis which offer much promise for tuberculosis in the future.

All aspects of the subject are considered in this book; the indications and contraindications for operation, artificial pneumothorax, choice of operation, preoperative management, anesthesia, tuberculous empyema. Each type of operation has a chapter in which the technic, advantages, dangers, and results are completely described. There is a bibliography of some 500 titles.

Surgical management of pulmonary tuberculosis is a relatively new subject, but its use in selected cases is bound to increase. It is important that internists and surgeons be well informed concerning the indications and contraindications for surgery, as well as the operative technic. This book is the best means, in the English language, to the acquisition of this necessary knowledge.

MODERN OPERATIVE SURGERY, edited by *H. W. Carson, F. R. C. S., (Eng.), Senior Surgeon, Prince of Wales's General Hospital, Tottenham: Lecturer on Abdominal Surgery, North-East London Post-Graduate College.* In two volumes. William Wood and Company, New York.

These books are most attractive in outward appearance, and the first favorable impression persists after an examination of their contents.

There are 43 chapters, each by an Englishman of high standing in his specialty. Among them are several names well known on this side, such as R. C. Elmslie, H. D. Gillies, E. W. Hey Groves, W. Sampson Handley, and Sir John Thomson-Walker.

As in other collaborative works, one finds a considerable variation in the quality of the material. Many chapters are of really distinquished excellence while a few are mediocre. The general average is very high. The reviewer would give the first place in order of excellence to the chapter on "Operations for abdominal injuries," by H. W. Carson. The diagnosis, operative indications, and technic are worth the price of the set. Many of the chapters have a summary of the results of the various operations which furnishes a valuable guide in choosing the procedure to be used.

The editor, collaborators, and publishers have each done their part well and have produced a most creditable work.

INSECTS AND DISEASES OF MAN, by *Carroll Fox, M. D., Surgeon, U. S. Public Health Service; Lecturer on Medical Entomology to class of student officers, Hygienic Laboratory, Washington, D. C.* P. Blakiston's Son and Co., Philadelphia, 1925.

The author presents in a concise and practical manner the subject of arthropoda of medical importance and the human diseases they transmit.

The book is divided into two parts. Part 1 is devoted to the identification and classification of those arthropods directly or indirectly associated with diseases of man or which act as human pests. Two outstanding features of this section of the book are the up-to-date keys for determining the genera and species of the various arthropoda and the many original illustrations showing in detail the anatomical parts considered in both text and keys. This is particularly striking in Chapter XVI, which discusses fleas. This part of the work concludes with a chapter on rodents and a chapter giving useful information on the methods of collecting, mounting, and preserving specimens.

Part 2 outlines in a practical way the important arthropodan diseases of man. The manner in which each disease is presented, especially as to the discussion of control and prevention, which includes several model ordinances, makes the book of especial value to the worker in the field.

Teacher, student, and particularly the field worker working along lines of preventable diseases transmitted by arthropods will appreciate the appearance of this volume.

DISEASES OF THE BRONCHI, LUNGS, AND PLEURA, by *Frederick T. Lord, M. D., Visiting Physician, Massachusetts General Hospital; Instructor in Medicine, Harvard Medical School.* Second edition. Lea and Febiger, Philadelphia, 1925.

This revised edition of Lord's well-known book has been made necessary by the great advances which have taken place in the knowledge concerning the diseases dealt with. Consequently, many changes have been made and much new matter added in order that the book might give to its readers the full benefits of this increased knowledge.

The chapter on atelectasis is of much interest and the importance of recognizing this condition when present and of preventing its occurrence are shown by the author.

A chapter on pulmonary tuberculosis which treats of this condition in all its phases has been added. In writing this the author has made use not only of his own experience but also of the best sources of information, as is shown by the extensive bibliography given. All the modern surgical procedures employed in treating pulmonary tuberculosis are mentioned and briefly discussed.

Lobar pneumonia is thoroughly discussed and all of the approved methods of treatment, including specific therapy, carefully described.

Lord believes in the prompt evacuation of pus from the pleural cavity as soon as the diagnosis is made and advocates, in most acute cases of emypema, the closed-suction method of drainage.

Other chapters deal with bronchostenosis; bronchial asthma; bronchitis (in its several forms); bronchiectasis; pulmonary abscess and gangrene; pulmonary thrombosis, embolism, and infarction; pulmonary syphilis; and the various diseases of the lungs due to the molds and animal parasites.

The book is well written, complete in all essentials, and will be a valuable aid to the physical diagnostician and internist in his work.

PREVENTIVE MEDICINE, by *Mark F. Boyd, M. D., M. S., C. P. H., Member of Regular Field Staff, International Health Board of the Rockefeller Foundation; formerly Professor of Bacteriology and Preventive Medicine in the Medical Department of the University of Texas.* Second edition. W. B. Saunders Company, Philadelphia, 1925.

The author defines preventive medicine as "that branch of applied biology which seeks to reduce or eradicate disease by removing or altering the responsible etiological factors." It includes both hygiene and sanitation, which are often confused with it.

The larger part of the book is devoted to a study of the diseases due to invading microorganisms or epidemiology. In this are discussed, in a simple, clear, and concise manner, the sources of infection; the spread of infective agents; methods of transmission of disease; general and special measures of disease control; the relation-

ship of water to health and disease; milk, foods, insects, and animals as sources of infection. The latest methods of water purification and of sewage disposal are given.

Section II deals with the deficiency diseases, under which the author classes alcoholism in addition to beriberi, pellagra, scurvy, and endemic goiter.

The occupational diseases are briefly discussed in Section III, while other sections take up the diseases arising from the puerperal state, diseases transmitted from parent to offspring, the hygiene of infancy, the hygiene of childhood, air, personal hygiene, statistics, and public health administration.

The book is excellently arranged and contains all the information necessary for the medical man who is not a specialist in preventive medicine. It is also an excellent book for the beginner in the study of preventive medicine who intends to continue his education along this line.

Proceedings of the International Conference on Health Problems in Tropical America, published by the United Fruit Company, Boston, Mass., 1925.

During the latter part of July, 1924, there was held in Kingston, Jamaica, under the auspices of the medical department of the United Fruit Co., an International Conference on Health Problems in Tropical America. The record of the proceedings of this conference was published early in 1925. But for an oversight notice of this book would have appeared in a much earlier issue of the Bulletin. It is now rather late to publish such a notice, but the papers contained in the record of proceedings are so valuable that they should be brought to the attention of all naval medical officers.

Dr. William E. Deeks, general manager of the medical department of the United Fruit Co.—himself an authority on tropical medicine—was the originator of the plan which led to the conference and was largely responsible for its success.

Eminent medical men were invited to attend as the guests of the United Fruit Co., which thereby set an example which might well be followed by other large corporations. The advantages gained by such an interchange of opinions and experiences are great, not only to the personnel of the company concerned but also to the world at large.

Among those whose papers appear in the proceedings may be mentioned Dr. Aristides Agramonte, "Some observations upon yellow fever prophylaxis"; Col. Bailey K. Ashford, United States Army, "Tropical sprue in Porto Rico"; Dr. F. G. Banting, "Insulin"; Dr. C. C. Bass, "The relation of the malaria carrier to malaria prevalence"; Dr. Aldo Castellani, "The treatment of oriental sore by

means of phosphorus" and "Tropical dermatology"; Dr. Seale Harris, "The food factor in pellagra"; Dr. F. M. Johns, "Some observations on granuloma inguinale and cultural studies of the Donovan bodies"; Sir W. Arbuthnot Lane, "The causation of cancer"; Dr. Hideyo Noguchi (in collaboration with others), "Experimental studies of yellow fever in northern Brazil"; Sir Leonard Rogers, "The prevention and treatment of amebic hepatitis and liver abscess"; Dr. M. J. Rosenau, "The seasonal prevalence of disease"; and Dr. Richard P. Strong, "The development of pathogenicity and parasitism in saprophytic microorganisms through the changed environment." The names of the authors is sufficient evidence of the character of the papers and of the worth of such a conference.

The "Proceedings" is a most valuable reference book, containing, as it does, the most up-to-date information on many of the tropical disease problems as they affect the Americas.

MANSON'S TROPICAL DISEASES, edited by *Philip H. Manson-Bahr, D. S. O., M. A., M. D., D. T. M. and H. (Cantab.), F. R. C. P. (Lond.), Physician to the Hospital for Tropical Disease, London, and the Albert Dock Hospital; Lecturer at the London School of Hygiene and Tropical Medicine; Consultant in Tropical Medicine to the Royal Air Force; etc.* Eighth edition. William Wood and Company. New York, 1925.

Manson's writings are so well known that comment on his original work is unnecessary. This edition has been reduced in size without omitting any of the essentials contained in previous editions. A wealth of illustrations of etiological factors and pathological lesions has been added. Among the newly adopted procedures used in the treatment of tropical diseases and described by the author are: X-ray therapy in oriental sore; yatren treatment for amebiasis; ethyl esters of chaulmoogra oil in leprosy; and protein shock treatment in tropical bubo.

For anyone interested in the progress of tropical medicine this book is of great value.

CLINICAL LABORATORY MEDICINE, by *Henry M. Feinblatt, M. D., Director of Laboratories, United Israel-Zion Hospital, and Assistant Clinical Professor of Medicine, Long Island College Hospital, Brooklyn, and Arnold H. Eggerth, A. B., A. M., Associate Professor of Bacteriology, Long Island College Hospital.* William Wood and Company, New York, 1925.

A textbook for students and practitioners of medicine in which the authors give not only the technique of all the established laboratory tests but, in addition, show the application of these tests to clinical medicine. Not written for the laboratory technician but for the general physician, the book gives specific directions for performing the tests described. Procedures not usually included in a laboratory manual are discussed, e. g., blood transfusions and immunization against diphtheria and scarlet fever. An unusually clear exposition of the subject of hydrogen ion concentration is given and basal metabolism determinations are well described.

The general practitioner, not entirely familiar with the latest advances in laboratory medicine, as well as the student, will find this a useful book to have on hand.

DEVELOPMENT OF OUR KNOWLEDGE OF TUBERCULOSIS, by *Lawrence F. Flick, M. D., LL. D., Organizer of the Pennsylvania Society for the Prevention of Tuberculosis, Cofounder of the Henry Phipps Institute, Ex-President of the International Antituberculosis Association, etc.* 738 Pine Street, Philadelphia, 1925.

This work of 750 pages is devoted to a study of the history of tuberculosis from the earliest days of recorded history down to our own times. The author has evidently delved deeply into the ancient lore of medical knowledge and has brought forth many facts and surmises of interest. Hippocrates, Galen, Aristotle, and other writers are quoted and discussed. Two very interesting chapters are devoted to a discussion of Morton's "Phthisiologia," written during the latter part of the seventeenth century. The author states of this: "Clinically, it is the best presentation of the symptomatology of tuberculosis that has been written."

Other chapters deal with Auenbrugger's discovery of percussion in 1761, Lænnec's contributions to the knowledge of tuberculosis, Virchow's studies of the pathology of the disease, the early experiments of Pasteur and others into the specific infectious nature of tuberculosis, the work of Villemin, the discovery of the tubercle bacillus by Koch in 1882 and the effect of his discovery, and other matters too numerous to mention.

The work concludes with a discussion of the reports made by the British and German commissions appointed to study the similarities and differences between human, bovine, and avian types of tubercle bacilli.

Anyone who wishes to know what has been thought about tuberculosis in days gone by and what difficulties have attended each forward step in understanding the disease will find this book of value. To the average medical reader it will hardly appeal greatly.

PHYSIOLOGICAL CHEMISTRY, by *Albert P. Matthews, Ph. D., Professor of Biochemistry, University of Cincinnati.* Fourth edition. William Wood and Company, New York, 1925.

The fourth edition of this well-known textbook for students has been enlarged, rearranged, and brought up to date so that it treats of all phases of biochemistry in the light of the most recent knowledge. The chapter on carbohydrates contains much new matter. More than 100 pages are devoted to a study of the blood, and a knowledge of all contained in these pages would be of great value to the clinician. The function of clotting is described in detail. The chemistry of the vitamins is given in the clearest manner possible.

Metabolism in all its phases is discussed and a chapter is devoted to the chemical defense against disease. In the latter part of the book practical work and methods are described, 337 experiments covering the subject of physiological chemistry being given.

This is a complete and useful textbook.

CHEMISTRY OF THE BLOOD IN CLINICAL MEDICINE, by *O. L. V. de Wesselow, M. B. (Oxon), F. R. C. P. (Lond.)*. William Wood and Company, New York, 1925.

The author has searched the literature carefully and has presented, in a most satisfactory manner, the value of chemical examinations of the blood. He discusses the normal constituents of the blood, acidosis and alkalosis, nephritis, rickets, gout, hydremia, and anhydremia, fat and lipoids, and anoxemia. Miscellaneous methods of examination are given in sufficient detail to permit one who is familiar with laboratory procedures to perform them.

RATS AND HOW TO DESTROY THEM, by *Mark Hovell, F. R. C. S.* William Wood and Company, New York, 1925.

Experience in destroying rats acquired by the author many years ago and a continued interest in the subject have made him an expert. The results of his experience are given in this book.

Many methods are described. The use of traps, snares, ferrets, dogs, poison, virus, flooding, fumigation, and other means is discussed and the relative worth of each under varying conditions estimated.

The author states as a fact that "rats recognize the smell of a human being and it suffices to put them on their guard." Therefore traps carelessly handled are valueless. He estimates the damage done by rats in Great Britain at £1,000,000 sterling per year. Thus the enormous economic importance of rat destruction is seen. In addition, the author stresses the importance of getting rid of rats as a means of disease prevention.

The approved methods of ridding dwelling houses, shops, warehouses, stables, the yard, chicken houses, pigsties, barns, and other places of rats are given. Of special interest to naval medical officers is the description of methods of ridding ships of rats. Rats on board ships, especially cargo carriers, are always a nuisance and often become a real problem. To rid ships of rats the author advocates continuous trapping. In addition he urges fumigation at frequent intervals and describes methods of doing this with sulphur dioxide and carbon monoxide. He says nothing about the use of hydrocyanic acid gas. He also believes in prevention, as shown by his advocacy of rat guards on the lines and a swinging door on the gangway whenever a ship is tied up to a dock.

This will be a valuable reference book for the naval medical officer as well as the average householder who is troubled by rats.

THE DIVISION OF PREVENTIVE MEDICINE

Lieut. Commander J. R. PHELPS, Medical Corps, United States Navy, in charge

Notes on Preventive Medicine for Medical Officers, United States Navy

HEAT CRAMPS AND HEAT EXHAUSTION ON BOARD SHIPS OF THE NAVY IN RECENT MONTHS

Fifty-six cases of heat cramps or heat exhaustion, most of them cramp cases, were reported by the U. S. S. *Wyoming* as occurring among members of the fireroom force in the month of June, this year. "Heat cramps" and "Heat exhaustion" are the two titles provided in the United States Navy Nomenclature and Classification of Diseases and Injuries to cover all cases of disability attributed to high temperature of the air, exclusive of sunstroke. The receipt in the Bureau of Medicine and Surgery of such an unusual number of morbidity report cards led to a request for information as to the conditions and circumstances under which the cases had occurred. The information furnished by the senior medical officer of the *Wyoming* in response to a letter to the commanding officer of that vessel requesting the same will be of interest to other medical officers.

In order to summarize the Navy's recent experience with such cases all Form F cards on file in the bureau which notified admissions to the sick list among men employed in firerooms and engine rooms of ships in 1924 and 1925 up to July 16 have been sorted with a view to statistical analysis. There appear to have been 82 cases of heat prostration as covered by the title "Heat exhaustion," and 105 cases of "Heat cramps."

The following table includes all admissions for disability attributable to heat or to heat and laborious work on board all vessels

of the Navy in 1924 and in 1925 up to July 16. The figures are given separately for fireroom and engine-room forces:

	Displacement	1924			1925		
		Engine room	Fire room	Total	Engine room	Fire room	Total
BATTLESHIPS, FIRST LINE	*Tons*						
U. S. S. Idaho	32,000		3	3			
U. S. S Arizona	31,400					1	1
U. S. S. Texas	27,000		1	1			
U. S. S. Arkansas	26,000		5	5			
U. S. S. Wyoming	26,000		2	2	1	81	82
U. S. S. Florida	21,825		8	8			
U. S. S. Utah	21,825	6		6		7	7
CRUISERS, SECOND LINE							
U. S. S. Seattle	15,500		1	1		3	3
U. S. S. Pittsburgh	13,680		10	10		8	8
U. S. S. Rochester	9,700		1	1			
LIGHT CRUISERS, FIRST LINE							
U. S. S. Concord	7,500				1	1	2
U. S. S. Marblehead	7,500					1	1
U. S. S. Memphis	7,500					1	1
U. S. S. Omaha	7,500				1		1
U. S. S. Richmond	7,500		1	1			
U. S. S. Trenton	7,500	1		1			
LIGHT CRUISER, SECOND LINE							
U. S. S. Denver	3,200	1	1	2			
DESTROYERS, FIRST LINE							
U. S. S. Case	1,215				1		1
U. S. S. Farragut	1,215		2	2			
U. S. S. William Jones	1,215		1	1			
U. S. S. Lamson	1,215		1	1			
U. S. S. Macdonough	1,215	1		1			
U. S. S. Osborne	1,215	1		1			
U. S. S. Preble	1,215	1	1	2		1	1
U. S. S. Shirk	1,215					2	2
U. S. S. Smith Thompson	1,215					2	2
U. S. S. Sturtevant	1,215				1		1
LIGHT MINE LAYERS							
U. S. S. Hart	1,191					1	1
U. S. S. Mahan	1,191					1	1
PATROL VESSELS							
Gunboats							
U. S. S. Tulsa	1,575		1	1			
U. S. S. Sacramento	1,423		1	1			
Converted yacht							
U. S. S. Niagara	2,600					3	3
AUXILIARIES							
Submarine tenders							
U. S. S. Camden	9,000					1	1
U. S. S. Beaver	5,970				1		1
U. S. S. Bushnell	3,580		1	1		1	1
Repair ship							
U. S. S. Vestal	12,585		1	1			
Aircraft tender							
U. S. S. Wright	11,000				1		1
Collier							
U. S. S. Jason	19,250					1	1

	Dis-place-ment	1924			1925		
		En-gine room	Fire room	Total	En-gine room	Fire room	Total
Cargo ship	Tons						
U. S. S. Beaufort	4,565					1	1
Oiler							
U. S. S. Sapelo	16,800		1	1			
Transport							
U. S. S. Chaumont	13,400		1	1			
Hospital ships							
U. S. S. Mercy	10,100		1	1			
U. S. S. Relief	9,800					1	1
Mine sweepers							
U. S. S. Falcon (Rescue)	950					1	1
U. S. S. Robin	950		1	1			
U. S. S. Woodcock	950	1		1			
Miscellaneous							
U. S. S. Abarenda	6,680					1	1
Unclassified							
U. S. S. Topeka	(?)		2	2			
Total		12	48	60	7	120	127

Obviously the numbers of cases of heat cramps and heat exhaustion occurring among men at work in the firerooms or engine rooms will depend upon many factors besides the type of vessel, indicated horsepower, and kind of fuel used. In making comparisons between vessels of different types and between the experience of any ship or group of ships in one year as compared with another many things must be taken into consideration. The character of the duty performed by the vessel in one year may be very different from that performed in another so far as related to heat hazards. Moreover, all factors which have a bearing on the physical condition of the personnel at the time cases of heat exhaustion or cramps are occurring must be taken into consideration.

The cases occur, of course, at sea during a steaming watch, and in most instances during a watch that is for one reason or another hard to endure, although in some cases a particularly unfit individual will exhibit symptoms when the atmospheric and working conditions are not regarded as in any way trying by the majority of men on watch at the time.

A priori, one might expect the number of revolutions being made during the watch to be a factor of primary importance in leading to heat exhaustion, providing weather conditions are not unusually conducive to the rapid removal of heated air from the firerooms and engine rooms. The speed maintained does have a direct bearing

upon the amount of work performed in the firerooms in coal-burning ships but not in oil burners. Even in the case of coal-burning ships which have reported cases of heat cramps and heat exhaustion from time to time only the *Utah*, *Arkansas*, and *Wyoming* experienced any difficulty in this connection during their full-power trials this year.

In the *Utah's* report it was stated that a large percentage of the men were very young and many of them had had but little experience in firing when called upon for maximum work. A few men were unable to complete their watches because of exhaustion, but they were not entirely incapacitated and were able to resume work after four hours of rest between watches. The weather conditions were not stated. The trial was held March 11 and 12, 1925, en route from Cuba to New York, where the ship arrived March 13. The highest temperature recorded in a fireroom was 112° F. The temperatures in engine rooms were not given, but the report states they were somewhat hotter than under usual cruising conditions. There was little or no suffering in the engine rooms.

In the case of the *Arkansas* the average physique of firemen was reported as low. The medical officer stated he believed the fireroom crew would be quickly rendered helpless from physical exhaustion under difficult conditions. In his opinion, during the last two watches of the endurance run the majority of the firemen were in the last stages of exhaustion. He reported that except for a few cases of nausea caused by exhaustion there were no casualties. The average temperature of the outside air during the trial was 75° F. The average temperature in the engine rooms was 114° F. and in the firerooms 95° F.

These two reports are exceptional. The reports from practically all other ships indicated that the men in both firerooms and engine rooms were experienced and in excellent physical condition. With the exception of these, and one other vessel to be mentioned, all ships reported that the full-power trials imposed no undue tax upon the endurance of the men, and it was not necessary to relieve any man because of fatigue or likelihood of heat exhaustion. The reports from many of the destroyers and from some of the high-powered light cruisers particularly noted that comfort conditions were better in the firerooms than under usual cruising conditions. In this connection it is of interest to note that the temperatures recorded in both firerooms and engine rooms were very much higher in some of the destroyers, light cruisers, and oil-burning battleships which reported comfort conditions as satisfactory and with no evidence of fatigue than the temperatures recorded for coal-burning battleships. There is, of course, a great difference in the amount of physical work required. A number of the reports from oil-burning vessels indi-

cated that six-hour watches could have been stood by the personnel, conditioned as they were, without ill effect or excessive fatigue. In one destroyer eight-hour watches were stood. Even with those watches the health and physical endurance of the personnel was reported as excellent.

The one exception, besides the *Utah*, *Arkansas*, and *Wyoming*, where signs of fatigue were noted, was a destroyer, the U. S. S. *Lamson*. She underwent a 24-hour trial January 5, 1925, in Cuban waters. The outside temperature was 80° F. The temperature in the firerooms was between 120° and 127° F. and in the engine rooms 110° and 114° F. One man was taken off watch from a fireroom when he began to show symptoms of heat exhaustion. The report stated that the ventilation was excellent and that all ventilating apparatus functioned properly. The rest of the men on watch felt no ill effects and were not unduly fatigued. The *Lamson* had a second trial March 21, 1925. The outside temperature was 74° F., but the temperatures below were higher than during the previous run. The temperature in the fireroom was 136° to 142°, and in the engine rooms 112° to 118° F. No man felt any ill effects.

The U. S. S. *Wyoming* had a full-power trial April 5, 1925. The physical condition and morale of the men during the trial were reported as excellent. Although the ship had just put to sea after a 10-day liberty period only one case of exhaustion occurred. The patient was a man who had been liberated from the brig the day before. The outside temperature was favorable, 54° to 60° F., but there was a fine rain which increased the relative humidity of the air. In the engine rooms the temperature ranged from 98° to 106° F. and the relative humidity was 81 per cent, as compared with 91 per cent in the outside air. Naturally this high relative humidity with the temperature above 100° F. caused discomfort in the engine rooms. Temperatures were lower in the firerooms—90° to 94° F. The fireroom force was reasonably comfortable and no great fatigue was experienced except by the man who was relieved. The report states that there had been for more than a year a shortage of personnel in the engineer's department of about 12 per cent below the peace-time complement, which had interfered with upkeep, particularly upkeep of boilers. Fifteen first-class firemen were discharged right after the full-power trial. During the trial the shortage in the engineer's department was made up with 54 men from the deck force, which made a full complement available for duty. Of the 54 men from the deck force, 24 did duty as mess cooks and compartment cleaners and 30 served as coal passers. All personnel stood the work well. The following special precautions probably contributed to this result: Special lunches were served following

watches, and deck space was specially assigned for resting day and night. In the fireroom the force stood watch on and watch off; in the engine room, watch in three.

It is clear that full-power trials were not responsible for the admissions for heat cramps and heat exhaustion shown in the table above. In the case of the *Wyoming*, which has reported in 1925 82 of the 127 admissions reported by all ships of the Navy up to July 16, dates of admission, considered in connection with movements of the ship, seem to indicate that heat-exhaustion cases are more likely to occur when steaming for many days at a moderate speed. Of course, in all cases a number of factors are involved. The final influence of determining importance is not infrequently high temperature and high relative humidity of the outside air. Other factors are length of the voyage, speed maintained, shortage of personnel, adequacy of rest periods between watches, physical make-up of the personnel, experience and length of previous training, physical condition at the time, and condition of the boilers and upkeep of machinery in general.

The *Wyoming* had her full-power trial April 5, 1925, en route between San Pedro and San Francisco, Calif. April 15 she sailed for Honolulu, Hawaii. No case of heat exhaustion was reported during that passage, but, in returning to the west coast after the maneuvers in Hawaiian waters, two cases occurred during the eight days the ship was at sea. The ship reached San Diego, Calif., June 18 and remained four days. The medical officer reported that while the ship was in port at that time liberty was granted and at the same time a very considerable amount of repair work was done on the boilers, so it would appear that the fireroom force had very little rest.

The ship sailed June 22 for Panama. On the run down, 56 cases of heat cramps or heat exhaustion occurred. The medical officer stated that for the first three days out the weather was comparatively cool and it was difficult to understand why cases of heat cramps were occurring. The first case appeared one day out of San Diego, and 4 the next day, followed by 2 the next. After that the temperature of the outside air was high and the weather was oppressive. On the fourth day, 19 cases occurred, on the fifth, 26 cases; followed by 3 and 1 during the next two days. The ship arrived at Balboa, Canal Zone, July 1.

The first day at sea the maximum temperature of the air on deck was 72° F. and the minimum 62° F. The second day the temperature ranged from 67 to 73° F. and the third day from 72 to 84° F. During these days the average temperature in the firerooms was 112° F. The temperature increased to an average of 125° F. for the next three days, the temperature ranging from 121 to 131° F.

During this time the temperature of the outside air varied between 81 and 90° F.

The weather was hot from June 25 to June 28. Admiral's inspection was held June 26 and 27. Preparations for the inspection, drills, policing, etc., put the crew on edge and necessarily interfered with rest periods of the firemen during the forenoons and afternoons.

The above-mentioned conditions, together with long hard cruising, sudden change from the cool brisk air of San Diego to the oppressive atmospheric conditions as the ship sailed south, appear to account for this unusual incidence of heat cramps and heat exhaustion among the fireroom force. No man in the engine rooms suffered any ill effects. It would appear that hard steaming was required on the way down.

From July 10 to July 17 the *Wyoming* was en route to New York. During this passage 17 more cases occurred as follows: Four cases July 10, 5 cases July 11, 4 cases July 12, 3 cases July 13, and 1 case July 16.

The medical officer of the *Wyoming* remarked in his report that the engine room and fireroom forces, as well as the rest of the crew, had been living and working under trying conditions since the latter part of January. The winter gunnery practice, extensive cruising, tactical maneuvers, war game in Hawaiian waters on an overcrowded, coal-burning ship proved to be quite a strain on the men. This was particularly the case for men in the engineer's department, for the boilers were in bad shape and throughout the cruise they required constant attention in the way of repairs and upkeep. This placed an added burden on the fireroom force. When the hot weather was encountered after leaving San Diego there was a noticeable "let-down" in the physical condition of the officers. This was also true of the crew. Everyone felt "washed out." It was noted that seasoned firemen fell by the wayside as well as new men and recruits from the deck force. The greater number of men admitted to the sick list were from firerooms where forced draft was used and a smaller proportion from those where natural draft sufficed, although the temperature averaged from 5 to 8° F. lower with forced draft.

The symptoms in cases reported as heat cramps were fever, usually about 100° F., moderate tachycardia, severe cramps in the abdomen and extremities, and occasionally vomiting. The duration of illness in most cases was about 48 hours. In the heat-exhaustion cases, of which there were few in comparison with the number of cases of heat cramps, the patients were prostrated when admitted, with subnormal temperature, cold moist skin, rapid pulse, and no cramps. Altogether there were only 6 cases of heat exhaustion.

The *Wyoming* was the only coal-burning battleship of the scouting fleet that took an active part in the program carried out by the battle fleet. The *New York*, *Texas*, *Utah*, and *Arkansas* took midshipmen from the Naval Academy on their summer cruise.

The *Utah* reported 6 cases of heat cramps or heat exhaustion in 1924 and 7 in 1925 to July 16. The *Arkansas* reported 5 cases in 1924 and none in 1925. The *Florida* reported 8 cases in 1924. She was not in full commission in 1925.

Reference to the table at the beginning of this article will show that conditions in firerooms and engine rooms of oil-burning ships altogether were responsible for only 19 admissions to the sick list with heat cramps or exhaustion in 1924—5 in engine rooms and 14 in firerooms. From January 1, 1925, to July 16, which period included the cruise of the Battle Fleet to Hawaii and maneuvers in Hawaiian waters, all oil-burning vessels in the Navy reported only 4 from engine rooms and 14 from firerooms. These were all single cases. While data which would show the conditions and circumstances under which these cases occurred are not available, the fact that only one man was affected in each instance would tend to indicate that work and atmospheric conditions were not solely responsible but that the physical condition of the particular individual was a contributing factor. One need not necessarily lack the physical qualifications required for fireman ratings to be affected by the heat while on watch in either fireroom or engine room. Many conditions may contribute to make an individual susceptible, such as digestive disturbances and other ailments, lack of sleep, effect of recent liberty, or temporary unfitness for hard work in high temperatures after a long liberty or overhaul period.

It is possible that the men in some instances were not physically qualified for duties in the fireroom. Paragraph 1532, Manual of the Medical Department, United States Navy, 1922, requires that in all cases where men request to be transferred from the seaman branch to the rating of fireman, third class, they shall be examined physically by a medical officer. Moderate height and compact build are requisite in the ratings of fireman. The duties pertaining to these ratings are or may be extremely arduous, and applicants for such positions and candidates for transfer to these ratings must conform in every particular to the required physical standard, as described in paragraph 1438 (*c*), Manual of the Medical Department.

It is understood that in view of the great amount of steaming required in recent months ships were ordered to keep engineer department personnel up to full complement even to the detriment of other divisions. One medical officer noted that a number of undeveloped boys were being employed down below when they should have been on deck. It appears that in some instances men were

assigned from deck divisions, whether they wanted such assignment or not, to go into the firerooms and perform the duties of fireman ratings.

Men who do not meet the physical requirements of the rating of fireman can not be expected to improve in health and physique as they would in the open air and sunshine. It would appear to be both detrimental and unjust to retain them in a position where they can not expect promotion and to require them to perform duties for which they are not physically qualified according to standards adopted by the Navy Department.

Experiences on board oil-burning battleships indicates that special attention should be given to the eardrums when candidates are examined for fireman ratings. In oil-burning vessels men often work under considerable air pressure. If there is a perforation the pressure prevents healing, and it is detrimental in other diseases of the ear.

The experience of the U. S. S. *Wyoming* indicates quite clearly what the major factors are that make for disability due to heat effects among men at work in firerooms in the presence of overheated air. It would be outside the scope of this paper to discuss the physiology and pathology of these conditions, but it may be remarked that the environmental causes are the same for heat cramps and heat exhaustion, and doubtless from the physiological standpoint these conditions have much in common up to a certain point.

Comparatively few cases of heat exhaustion occur. The majority of men actually disabled as a result of the combined effects of muscular work and exposure to overheated air have cramps. Exactly why they have cramps remains to be determined—possibly it is due to depletion of sodium chloride or other essential chemical agent, brought about through excessive sweating. Experienced firemen have conflicting ideas regarding the amount of water to be drunk while on watch, standing in direct line with blowers, the effect of drinking ice-cold water, etc. In the heat-exhaustion cases there seems to be complete failure, at a certain stage, of the heat-regulating functions of the skin and sympathetic nervous system with concomitant cessation of heat production. The body temperature ceases to rise, and the body begins to cool. The temperature is usually subnormal by the time prostration becomes apparent. As a rule such patients do not have cramps. The relatively small incidence of such cases, when most men exposed to the physical conditions that tend to make physiological adjustment difficult have cramps instead of adynamic exhaustion, would seem to indicate that the factors of final determination rest within the individual and relate to his own peculiar reactions in dealing with the output of

heat incidental to increased oxidation involved in muscular exertion in the presence of heated air. Hard muscular work is, of course, a factor in most cases, but it is clear from the studies made by Surg. R. R. Sayers, United States Public Health Service, Chief Surgeon, Bureau of Mines, United States Department of the Interior, and colleagues, of the effects of exposure to still, saturated, heated air, that some individuals can be expected to develop typical heat exhaustion, as we know it, if exposed for a comparatively short time while completely at rest in still air with the relative humidity 100 per cent and the temperature 100° F.

The morbidity returns from ships do not in themselves indicate that cases of heat cramps are more common than cases of heat exhaustion. In 1924 there were notified by all ships 16 admissions with heat cramps and 44 with heat exhaustion. In 1925, to July 16, all ships reported 89 admissions for heat cramps and 38 for heat exhaustion. It is probable that in some cases the title, heat exhaustion, was used even though the patient was admitted on account of muscle cramps and twitchings, there being a certain amount of weakness or exhaustion from fatigue and the medical officer not making a close discrimination between the two nomenclature titles. In a good many cases the diagnosis was made on board destroyers by hospital corpsmen serving independently. The experience of the *Wyoming* during a period when the worst conditions to be expected were encountered would seem to indicate that real cases of heat exhaustion are uncommon.

Several years ago Commander Charles N. Fiske, Medical Corps, United States Navy, made a study of heat cramps and heat-exhaustion cases. He reported that in 1909 and 1910 the attack rate for heat stroke in the Navy was about 8 per 1,000 and that there had been 20 deaths from this cause between 1861 and 1911. During the same period 33 men were invalided from the service, permanently disabled. He attributed the severe cramps and muscle twitchings to local dehydration of the tissues and accumulation of katabolic products. In such cases the body temperature regulation may be completely upset so that a fever temperature of several or many degrees may be found. In commenting upon the findings and conclusions published by Fiske, Dr. C. E. A. Winslow states that the symptomatology and pathology strongly suggest autointoxication due to metabolic products and a striking analogy with the phenomena of fatigue.

These ideas are all consistent with the environmental conditions and personnel factors are observed, but they do not lead to an understanding of why some men under given conditions have heat cramps but more at the same time do not, while more rarely some individual develops heat exhaustion. The field is still open to research.

OUTBREAK OF FOOD POISONING AT THE NAVAL PRISON, NAVY YARD, MARE ISLAND, CALIF., ATTRIBUTED TO FROZEN LIVER

By E. L. JONES, Lieutenant Commander, Medical Corps, United States Navy

On August 28, 1925, at 6 a. m., the medical officer of the day was called to the naval prison, Mare Island, Calif., to attend men suffering from cramps in the abdomen.

Of 242 prisoners, 91 were found to be ill. In addition a gunner on duty at the prison and a sergeant major were affected.

All were affected at about the same time in the early morning hours. In nearly all cases the onset was sudden with cramps in the abdomen as the first indication of illness. In most cases diarrhea with profuse liquid stools followed within an hour. No blood was noted in any of the stools. Some of the patients were nauseated, but none vomited. Most of them had colicky pains for several hours. Some of the patients had as many as 10 bowel movements in an hour.

Some complained of chilliness, and marked chills were noted in a few cases. Temperatures in the early hours were between 99° and 100° F. Three hours later, in most cases, the temperature was found to be between 101° and 103° F. In a few cases the temperature rose to 104° F.

Physical examination at this time disclosed congested and slightly swollen faces, with no other findings as to congestion of the lungs or elsewhere. There were no disturbances of reflexes. In most cases the heart sounds were forcible, the pulse rate was accelerated, and a tendency to dicrotism was observed. Slowing of the pulse rate during convalescence was noted. In one case the rate was 52.

In general there was but slight prostration at the time of onset, but weakness was more noticeable after a few hours. Within three hours prostration was quite marked in some cases.

Severe frontal headache was a common symptom. Some of the patients complained of continuous abdominal pain. Only a few had cramps in the muscles of the extremities and trunk.

The white-blood count in a typical case was 13,500, with polynuclear neutrophiles 76 per cent. Specimens of blood from eight of the patients treated in hospital were examined by Lieut. H. E. Ragle, M. C., United States Navy. The maximum, average, and minimum counts were as follows:

	Maximum	Average	Minimum
Leucocytes	8,200	6,500	4,450
Neutrophiles ... per cent	80	60	49
Lymphocytes ... do	46	34	15
Large mononuclears ... do	5	3	6
Transitionals ... do	5	2	1
Eosinophiles ... do	2	1	1

Blood cultures were taken from the 4 patients who seemed to have the most severe symptoms. None showed any growth.

Urinary findings were not significant.

Of the 36 patients transferred to hospital, 23 were discharged to duty within four days and the remainder a few days later. The men treated at the prison recovered within three to five days.

All patients were given an ounce of castor oil, followed by salol and sodium bicarbonate every four hours. An emetic was not given because none of the men had eaten since the evening of the day before. No other treatment was used except that fluids were forced, by mouth and cold packs were applied to the head. Among the hospital cases, temperatures ranged from 101° to 104° F. Pulse rates and temperatures were taken every four hours.

The men affected believed that liver eaten at the meal the night before was the cause of their illness. The gunner on duty at the prison, who was among those affected, partook of the noon and evening meals, but previously he had not eaten at the prison for several days. He was taken ill at the same hour and with the same symptoms as the prisoners. The sergeant major on duty ate only the evening meal, August 27, at the prison and he became ill.

The menus served on the 26th and 27th of August were as follows:

August 26, 1925

BREAKFAST	DINNER	SUPPER
Fried pork sausage.	Fried beefsteak.	Chili-con-carne.
Cream gravy.	Brown gravy.	Fried potatoes.
Boiled potatoes.	Au gratin potatoes.	Vegetable salad.
Persian melon.	Boiled summer squash.	Bread.
Bread and butter.	Tapioca fruit pudding.	Fruit jam.
Coffee.	Bread, butter, and coffee.	Tea.

August 27, 1925

Minced beef on toast.	Barley soup.	Fried liver and onions.
Fried potatoes.	Pot roast of beef.	Gravy.
Rolled oats.	Vegetable gravy.	Lyonnaise potatoes.
Milk and sugar.	Mashed potatoes.	Sliced tomatoes.
Bread, butter, and coffee.	Creamed carrots.	Bread, butter, and coffee.
	Bread, butter, and coffee.	

Inspection of the galley and questioning of the commissary steward and cooks as to the handling, cooking and serving of the meals, revealed nothing unusual. The commissary steward stated that there were no left-overs, it being the practice to serve any left-overs as seconds. As a consequence no portion of the food served could be obtained for laboratory examination. All meats, butter, and eggs

served at the prison are received from the yard barracks. Fresh vegetables are supplied from the prison garden.

Cultures were made from the stools of 35 of the 36 prisoners admitted to the hospital. They were plated upon lactose litmus agar plates. The colonies were examined and the Gram negative motile bacilli were transferred to the various sugar medias. None showed the cultural characteristics of the paratyphoid or enteritidis group.

It is known that a number of bacilli of the meat poisoning group, especially those most closely resembling the *Bacillus of Gärtner*, contain an endotoxin resistant to heat. It is possible in these cases that, while the infecting organisms may have been killed by the cooking, there was sufficient quantity of the endotoxin present to produce the symptoms.

The liver served at the evening meal on August 27 was ordered August 21 from the commissary officer, marine barracks, navy yard, Mare Island, Calif., and was received August 26 on invoice S. and A. No. 48, dated August 21, which called for 60 pounds of liver in wooden boxes. The liver was inspected as to weight by the junior officer of the day at the prison at the time of delivery. It was received frozen and was kept in the refrigerator until issued by the commissary steward to the cooks on Thursday, August 27, 1925, at 3 p. m. It was served at 4.30 p. m.

The pot roast served at the noon meal August 27 was prepared from fresh beef. Beef is received chilled and placed in the refrigerator until issued. All vegetables served were freshly prepared. The minced beef for breakfast was made of fresh beef ground. The chili-con-carne served at supper on August 26 was prepared from fresh beef. The vegetable salad was prepared from fresh vegetables from the prison garden. The fruit jam was freshly opened. The tapioca fruit pudding served at dinner on August 26 was prepared from canned peaches freshly opened. The fried pork sausage served for breakfast on August 26 was received from the yard barracks frozen.

All meats, butter, and eggs are Government inspected in San Francisco before delivery at the navy yard. The yard barracks is provided with a cold storage, where these foods are kept until issued. Frozen goods received at the prison have been satisfactory.

The present galley at the prison is an old antiquated structure. It is to be torn down within the next few days to give way to a new modern building. This building will afford larger refrigerator space. The equipment of this building should include a modern sanitary dish-washing unit. This has been recommended. The mess hall has been recently rescreened as a protection against flies.

REFERENCE

Bacteriology, Hiss and Zinsser, page 433.

Editorial comment.—The evidence presented seems sufficient to indicate that the fried liver served at supper August 27, 1925, was the cause of the outbreak. Minced beef served for breakfast the same day, which would ordinarily fall under suspicion, is pretty well ruled out by the fact that two of the patients did not eat that meal. The incubation period as fixed by the time of onset in the earliest cases shortly before 6 a. m., August 28, is most likely to have extended from the evening meal rather than breakfast.

A striking feature of the outbreak in comparison with outbreaks of food poisoning which have occurred on board ships of the Navy from time to time and which have been discussed in previous numbers of the BULLETIN is the continuation of fever for several days in a considerable proportion of the cases. This could best be explained on the assumption that living microorganisms were ingested and the patients became infected, just as happened in the outbreak which occurred among marines in camp at Guantanamo Bay, Cuba, a few months ago. That outbreak, it will be remembered, was traced for all practical purposes by Lieut. H. B. La Favre, Medical Corps, United States Navy, to contaminated Cuban beef served as fried beefsteak. In that outbreak a bacillus belonging to the paratyphoid group was isolated from the blood and from the stools of some of the patients. In outbreaks which have occurred on board ship, caused by hash served for breakfast which, presumably, was contaminated by carriers or otherwise only a few hours before the hash was cooked, the outstanding feature has been quick recovery from symptoms even in the cases where the symptoms were violent at the onset. In nearly all cases the patients were fit for duty the following morning.

In the outbreak now under discussion a great deal of work was done in connection with the attempt to isolate the causative agent from the blood and stools of patients. Blood cultures were attempted in 4 cases and the stools of 35 patients treated in hospital were plated out. It will be noted, however, that the solid medium used was lactose litmus agar. The failure to detect a member of the *B. enteritidis-paratyphoid* group is not as significant, therefore, as it would have been if Endo's medium or a properly working Conradi-Drigalski medium had been employed.

The circumstances in this outbreak were such as to make it altogether improbable that the liver was contaminated either by handling or by rodents or vermin after it was received at the prison. At any rate there appears to have been no opportunity for development of toxin at a temperature favorable for bacterial growth. It is therefore to be presumed that the liver or so much of it as was

contaminated came from an infected animal, or was contaminated from intestinal contents at the time of slaughter, or was subsequently inoculated by handling, by rodents, by vermin, or by flies, and that it was exposed to comparatively high temperature for many hours some time before it was frozen and delivered to the navy yard.

SMALL OUTBREAK OF FOOD POISONING ON BOARD THE U. S. S. COLORADO ATTRIBUTED TO BOILED HAM

A small outbreak of food poisoning, presumably caused by contamination of boiled ham with bacilli of the meat-poisoning group, occurred on board the U. S. S. *Colorado*, September 12, 1925. Only 51 members of the crew were affected.

Boiled ham served at the midday meal was thought to be responsible. The patients reported at the sick bay late in the afternoon with symptoms of acute gastroenteritis. None was dangerously ill and only a few had serious symptoms. All but 10 had recovered sufficiently to return to duty the next morning, and these 10 were discharged to duty after sick call the following morning.

Study of the outbreak showed that the only food eaten in common by the 51 men affected was boiled ham. Seventeen of the patients had been ashore on liberty during the afternoon. Of these, 10 had eaten fruit, ice cream, or taken some variety of soda pop while ashore. The other 7 had taken nothing. In all, 407 men had liberty but only 17 were among the 51 poisoned.

The suspected ham had been boiled the previous day at about 2 p. m., and it had been allowed to cool during the night. At about 6 o'clock in the morning the hams were sliced, the pieces were arranged on platters, and these were placed in steam ovens, where they remained for about five hours until issued for dinner at about 11.30 a. m. The temperature in the ovens was suitable for the growth of bacilli.

Practically every member of the crew, numbering about 1,300 men, ate some of the ham at the noon meal, so it is probable that only a few of the 80 hams that were consumed at this meal were contaminated.

Examination of the remaining hams of the same shipment as those used September 12 showed that some of them were soft and mushy close to the bone. The shipment was a large one furnished by the U. S. S. *Bridge*. Markings on boxes indicated that it had been packed in June, 1925. Prior to September 12, 2,800 pounds of the ham had been used on board the *Colorado* without causing any ill effects.

The medical officer recommended that in the future no prepared food be kept for such a long period in the steam ovens, and the com-

manding officer indicated that that recommendation would be followed. The above information was taken from a report of the outbreak furnished the commander of Battleship Divisions, Pacific Fleet, by the commanding officer of the *Colorado* in order that other vessels might be advised of the circumstances.

It has since been ascertained that the medical officers considered the possibility that the block or table on which the hams were sliced had become contaminated from contact with raw meat. This does not seem very probable.

One possibility is that one of the cooks who sliced the meat was a carrier with soiled hands and that he contaminated the slices he handled until there were no more microorganisms left on his hands. The meat was exposed to incubator temperature only for a few hours, but the cases were mild. That is consistent with a small amount of toxin production. On the other hand, most of the patients recovered in a few hours. In general, one would expect some among 51 patients to have had symptoms for two or three days if living bacilli were ingested, as would have been the case if the meat was contaminated after it was cooked. However, no hard-and-fast rule can be laid down to cover this point. In the cases which occurred among marines at the naval station, Guantanamo Bay, Cuba, where it was demonstrated that living bacilli had been ingested, some of those who became ill were not severely affected and they recovered in a few hours, although the sickest patients were ill for several days with fever and other symptoms indicative of infection.

The alternative assumption in the *Colorado's* outbreak is that one good-sized ham among the 80 used was toxic as a result of contamination at the time of slaughter or because the meat came from an infected hog and opportunity for incubation was afforded before it was subjected to the preserving process. On the whole, this seems more likely than the assumption that freshly boiled ham contaminated either by hand or cutting table could develop sufficient toxin in five hours to account for the outbreak.

A CASE OF FOOD POISONING WITH UNUSUAL SYMPTOMS

The following case was reported by Lieut. Commander C. W. O. Bunker, Medical Corps, United States Navy. An ensign ate a broiled lobster in a restaurant in Marseille, France, at about 8.30 p. m., April 19, 1925. A live lobster was brought in for his inspection, after which it was taken to the kitchen to be prepared. The lobster he ate was not necessarily the one he had inspected.

The patient stated that he ate only about half of the lobster because of a peculiar taste which at the time he attributed to the rich sauce served with it. The lobster meat smelled all right and was

of good appearance. Besides the lobster he ate two or three stalks of asparagus and drank one glass of wine.

All food eaten during the preceding 48 hours was eaten on board the U. S. S. *Scorpion* in the wardroom mess and no other member of the mess became ill.

The patient ate the suspected meal in company with a civilian who did not eat any lobster meat but who partook of everything else that the patient did. The civilian did not become ill.

The first indication of illness appears to have been a sharp metallic taste about four hours after the lobster was eaten. The patient was unable to get rid of the taste by rinsing his mouth with water. In about 20 minutes he had a feeling of numbness in the legs, feet, and hands. He tried to overcome this by walking but was unable to do so.

The patient was seen by the medical officer about 30 minutes after the illness began and symptoms continued for about four hours. Six ounces of a saturated solution of magnesium sulphate was given at once. About an hour later the patient had a watery stool and this was followed by three others during the next three hours. The stools smelled very strongly of sulphides.

There was no pain.

Shortly after the medical officer arrived ptosis of both eyelids was observed. This lasted for about three hours. There was no blurring of vision or diplopia. The pupils were normal in size, equal, and reacted to light. The test for accommodation was not successful. There was a continuous movement of both eyeballs but no definite nystagmus.

Shortly after the medical officer reached him the patient had an attack of dyspnea, during which the respirations were of the Cheyne-Stokes type. During the course of three hours there were three attacks of dyspnea. Strychnine sulphate was given by hypodermic injection at the height of the first attack, which soon ceased. The second attack lasted 10 minutes. During the first two attacks the patient complained of loss of function in the muscles of the upper abdomen and lower part of the chest, beginning with the lower muscles and gradually creeping upward. There was interference with normal respiratory movements, and to overcome this the patient would raise his arms from his side to above the head at the rate of about twenty times per minute. Inspiration was very noisy. The third attack was worse and required artificial respiration for a short time. An injection of caffein-sodium benzoate was given. The interval between the first and second attack was about 30 minutes, during which there were 15 to 18 respirations per minute, very quiet, regular, and shallow. The interval between the second and third attacks

of dyspnea was about 40 minutes. During this time the breathing was very shallow.

For a period of about two hours, beginning about 15 minutes after the dose of magnesium sulphate had been given, there was paralysis of the extensor muscles of the forearms and legs, causing typical wrist and foot drop. There was also paralysis of facial muscles, especially around the mouth, giving the patient the appearance of having a double Bell's palsy. There was some slurring of speech, but no difficulty in swallowing, although the patient stated that the lining of his throat felt as if it were thrown up in folds.

After the third attack of dyspnea had ceased, the ptosis and other paralyses gradually disappeared in the course of an hour, and the patient made an uneventful recovery.

The patient was conscious, and his mind was clear throughout the attack except for about 30 seconds when he was in syncope during the third attack of dyspnea. In the beginning of the illness he induced vomiting by putting his fingers in his throat. There was no further vomiting except after the first attack of dyspnea, when he became slightly nauseated and vomited a small amount of greenish fluid. There was no intestinal colic or abdominal distention. There was no chill or chilly sensation and no fever. The patient's temperature during the attack was 97.8° F. There was no headache and no muscular soreness until the acute attacks had been over for several hours. There was moderate prostration. The mouth was very dry, and the sharp metallic taste continued during the three or four hours in which nervous symptoms were present. The urine was examined. The findings were negative. No blood count was made.

The pulse rate was 105 before the severe attacks of dyspnea began. While dyspnea was present, the rate was between 135 and 140 beats per minute, and the pulse was weak and slightly irregular. After dyspnea ceased the heart slowed down to 50 to 55 beats per minute and then increased to 86 in about an hour.

Editorial comment.—In this case the nature of the poisoning is not clear. The clinical picture was certainly very different from food poisoning caused by contamination of beef or other meats with bacilli of the *B. enteritidis-paratyphoid group.* Of course the meat of shellfish may be contaminated with bacilli of the meat poisoning group either from contact with polluted water or by handling. Our records indicate that poisoning of this comparatively well-understood variety has not infrequently in single or isolated cases followed the ingestion of contaminated lobster meat, especially after eating crawfish in Porto Rico and in restaurants ashore in other places. In those cases the symptoms were not essentially different from the symptoms observed in outbreaks of food poisoning caused

by hash, hamburger steak, liver, chicken, and sliced meats of various kinds kept over for several days after cooking. No signs of nerve involvement have been reported.

The symptoms and signs in the case under discussion bore some resemblance to those which have been observed in certain cases in the Tropics following the ingestion of fish regarded as intrinsically poisonous, which, if not poisonous all the year round, at least appear to be so at certain seasons of the year. However, there was the striking difference that, although there was sufficient poisonous effect upon the nerves to produce paralysis of various groups of muscles, all symptoms disappeared in a few hours. After eating fish of a poisonous species the affected individual usually continues to have numbness or signs of motor nerve involvement for several days. We have no references at hand which would indicate that a poisonous species of lobster has ever been recognized as coming from the waters of the North Atlantic Ocean or Mediterranean Sea. If any reader has knowledge that bears upon the question of intrinsically poisonous shellfish of that variety, correspondence is requested.

Doctor Bunker in this case considered botulism and food poisoning caused by some member of the *B. enteritidis* group, but stated that the cause of the symptoms was not obvious to him. Although the peripheral nerves are affected in botulism, he remarked that the early onset of symptoms, short duration, rapid recovery, absence of diplopia, and lack of involvement of the pharyngeal muscles were against botulism. He stated that if pressed for a differential diagnosis he would say enteritidis group poisoning because of the early onset, transitory nature of the attack, and rapid recovery.

We are unable to make a more definite statement. The principal object in reporting the case in detail is to record the circumstances and observations so that they may be available to those who are interested in the study of food poisoning which in its broader aspects is of considerable importance to public health. As we have remarked before, it is clear enough that, exclusive of botulism, when poisoning results from eating flesh or organs from animals or other foods from land sources it is almost always due to contamination by some member of the *B. enteritidis-paratyphoid* group. But it is by no means clear that the meat of shellfish may not occasionally be rendered poisonous by putrefactive changes or by the action of microorganisms which cause spoilage. This possibility is not inconsistent with the evidence, which seems to indicate that in most cases where poisoning follows the ingestion of crab meat and other shellfish not infrequently taken from polluted sea water and even lobsters, which as a rule are taken from deeper water, the cause of poisoning is contamination by some member of the meat-poisoning group.

However, in view of the fact that the symptoms in this case were entirely different from the symptoms almost invariably observed when the attending circumstances incriminate the *B. enteritidis-paratyphoid* group of bacilli, it seems reasonable to conclude that some other explanation must be sought. It seems justifiable, therefore, not to dismiss the possibility that cleavage products of lobster proteins may actually have exerted the poisonous effect upon nerve tissue. This is a roundabout way of saying ptomaine poisoning, a term which should always be avoided, first, because the condition is probably rare and the diagnosis should not be made until the common form of food poisoning has been ruled out, and second, because the abuse of the term by physician and layman alike has been a serious handicap in the study of food poisoning and in the application of preventive measures.

CASES REPORTED AS INFLUENZA OF THE GASTROINTESTINAL FORM

In a paper on influenza submitted to the bureau, Lieut. (Junior Grade) W. S. Sargent, Medical Corps, United States Navy, describes an outbreak which occurred on board the U. S. S. *Tennessee* in June and July, 1925. While there were a number of typical cases with inflammation of the mucous membranes of the upper respiratory passages, there were along with these, and especially in the latter part of the outbreak, a greater number which Doctor Sargent regarded as cases of the gastrointestinal form of influenza. There are two cases without local manifestations, conforming to the type described in textbooks as the febrile type and there were three that were regarded as examples of the nervous type.

There were no deaths and few serious complications. No patient developed bronchopneumonia, but the following complications observed tended to confirm the conclusion that the disease was true influenza: Acute otitis media, sinusitis, anosmia, conjuntivitis, iritis, herpes, trifacial neuralgia, peripheral neuritis, arthritis, and asthenia. Appendicitis seemed to be a sequel in a number of cases. Asthenia continued in several cases and one case of active tuberculosis of the lungs developed.

The *Tennessee* carried between 1,350 and 1,400 officers and enlisted men. In January and February, 1925, the ship spent most of the time in San Pedro, Calif., but visited San Francisco in January. March was spent at San Pedro. April 15 the ship departed from San Francisco with the Battle Fleet for Honolulu. In June she went to Pago Pago, Samoa, and in July to Sydney, Australia. From there she went to Auckland, New Zealand, and then to Pago Pago in August before returning to Honolulu and the United States.

During April, May, and the early part of June there were among the crew nearly a hundred cases of what was regarded as catarrhal fever, although it is possible that some or many of these colds were really cases of influenza. A few of the cases were recorded as influenza—1 in February, 1 in April, none in May, but 2 in the first 10 days of June, after which about 10 days elapsed before another case which seemed to be influenza appeared. Cases then occurred in considerable numbers, and it was realized that there was an outbreak of influenza on board. Unlike outbreaks which occurred on board ships of the Navy in 1918 and in following years, when the disease was epidemic after the last pandemic, the outbreak did not spread through the crew rapidly for a few days and then cease, but continued for the greater part of two months.

The epidemic continued in spite of summer weather and such measures as could be employed in the presence of overcrowding and other essential conditions incidental to life on board a battleship. Isolation was enforced in so far as practicable.

At first the cases were of the respiratory type. As the epidemic progressed cases which were regarded as the gastrointestinal form of the disease began to appear along with those of the respiratory type. Altogether during the course of the outbreak there were more of the former.

The most frequent complaint in all cases was "aching all over." In the respiratory type, weakness, nasal obstruction, and rawness of the throat were commonly noted, while diarrhea and abdominal pain were the outstanding symptoms in the gastrointestinal type, along with prostration and congestion in the nose and throat. Vomiting was not a prominent symptom. Headache was present in nearly all cases, regardless of the form of the disease.

In most cases, regardless of type, there were fever, prostration, general aching, and mental depression. Some involvement of mucous membranes could usually be detected. In most cases the disease lasted only three or four days, and in general the subjective symptoms were out of proportion to the physical signs. In cases in which the blood was examined the white count was below 9,000.

Physical condition apparently had little bearing on the attack rate. Very robust subjects appeared to be as prone to attack as those who were in relatively poor condition.

Throughout the epidemic period there were mild cases with symptoms like those of ordinary colds. Apparently these were not recorded as influenza, although, in looking back on the outbreak, the medical officers appear to have regarded them as mild cases of influenza. The report did not include an exact statement as to the total number of cases comprising the epidemic.

An epidemic of influenza occurred on board the U. S. S. *West Virginia* in April, 1925, beginning April 17 and running a more or less typical course over 13 days, as follows: 4, 5, 7, 6, 9, 37, 17, 18, 9, 4, 2, 1, 5, 0. The medical officer was unable to determine the source from which the infection was imported. The outbreak developed at sea, as not infrequently has been the case when influenza has spread on board naval vessels. It began two days after sailing from San Francisco for Honolulu with other ships of the battle fleet. A few days before sailing large drafts of men from three training stations were received on board for further distribution. Some of these men may have introduced the infection or it may have been picked up by men on liberty in San Francisco. In the beginning the cases were regarded as common colds, but, when the cases were occurring in considerable numbers and when an epidemic curve became manifest, some of the cases were obviously influenza. Although many of the cases had been recorded as catarrhal fever, in looking back over the epidemic period the medical officer judged that the incidence of influenza had been as indicated by the figures given above.

It is interesting to note that this outbreak was not essentially different in its principal features from epidemics which have occurred from time to time since 1918. On board the *Tennessee* cases continued to occur during June and July, so that the epidemic period was regarded as covering about two months, and there were numerous cases like the gastrointestinal form frequently observed in the early nineties, a few years after the 1889–90 pandemic.

NEWSPAPER MISINFORMS THE PUBLIC REGARDING THE ADEQUACY OF RESUSCITATION MEASURES EMPLOYED IN A CASE OF DROWNING AT THE PHILADELPHIA NAVY YARD

An officer attached to the U. S. S. *Hannibal* fell from the gangway of that vessel into the water and was drowned. He was a fine swimmer, but it was observed that he made no struggle in the water and sank at once. Post-mortem examination revealed contusions of the scalp in the left parietal region. Presumably he struck his head on some hard substance in falling and was unconscious when he entered the water.

Every possible effort was made to rescue him. The officer of the deck and three other men jumped into the water after him. His body was recovered by grappling hooks 13 minutes after he fell overboard.

Meanwhile an ambulance had been dispatched from the United States Naval Hospital at League Island carrying a medical officer from the hospital. Artificial respiration by the approved Schaeffer

method was begun immediately and continued for more than two hours until it was apparent that life was extinct. The medical officer of the day from the navy yard dispensary assisted in efforts at resuscitation.

The next morning the following appeared on the front page of one of the Philadelphia daily papers:

NAVAL OFFICER DIES AS HOUR IS LOST SEEKING PULMOTOR—HOSPITALS AND POLICE JOIN IN SEARCH FOR RESUSCITATION DEVICE

LIEUTENANT DROWNS IN FALL OFF GANGPLANK IN ATTEMPT TO BOARD SHIP HERE

Efforts to save the life of Lieut. S. H. W. Jackson, of the U. S. S. *Hannibal,* at the League Island Navy Yard failed last night after an hour was spent in locating a pulmotor.

Lieutenant Jackson, a resident of Glenridge, N. J., and a Naval Academy graduate of 1921, was drowned when he fell from a gangplank into 30 feet of water while attempting to board his ship, anchored at Pier No. 2.

After 10 minutes of feverish diving and grappling by enlisted men of the *Hannibal,* a survey ship, and members of the crew of the U. S. S. *Nebraska,* anchored near by, the body was brought to the surface and Dr. J. S. Moriarity, of the naval hospital, sent out a request for a pulmotor.

The contrivance—an apparatus used to resuscitate drowned persons—could not be found at the naval hospital. The police of the Fourth Street and Snyder Avenue station were telephoned and asked to speed one to the scene of the drowning.

ARTIFICIAL RESPIRATION FAILS

The police station did not have one, and they relayed the request to the Methodist Hospital, which, not having one, communicated the request, in turn, to the police of the Twenty-fourth and Wolf Streets station.

In the meantime Doctor Moriarity and two aids were applying artificial respiration to the unconscious man. Sergeant Magee, at the Twenty-fourth and Wolf Streets station, telephoned to St. Agnes Hospital, at Broad and Mifflin Streets, and was informed that a pulmotor was available.

Policeman Carroll, at the wheel of a bandit chasing "flivver," was ordered to speed to the hospital, get the pulmotor, and race to the navy yard. Three minutes after leaving the hospital Carroll was speeding through the navy-yard gates.

When he reached the *Hannibal* it was 9.30, just 59 minutes after Doctor Moriarity made the original request for the pulmotor. An hour's work failed to revive the man and the struggle for his life was given up. Naval authorities, after an investigation, made public the details of the accident.

A supply officer attached to the navy yard at Philadelphia clipped the article from the paper and sent it, with a memorandum, to a medical officer with whom he is acquainted who is attached to the United States naval medical supply depot, Brooklyn, N. Y. He took the view that public opinion is inflamed by such articles. He evidently felt that it called for a statement of the facts.

The facts as ascertained from the commanding officer of the United States naval hospital, League Island, Pa., are that no medical officer or hospital corpsman of the Navy made any request for a

pulmotor, and when one was brought to the scene where artificial respiration was being given the medical officer did not use it. The request for a pulmotor was made by a layman whose name is not known.

Acting upon recommendation of the Bureau of Medicine and Surgery, the Navy Department refuses to approve requests for resuscitation apparatus of the type represented by the pulmotor.

Efforts by governmental agencies and industrial bodies to educate the public and employees exposed to the risk of drowning, to electric shock, or to asphyxiation by carbon monoxide or other gases are greatly retarded by such newspaper articles. For that reason news items which mislead the public should not be passed by without comment. Medical officers of the Navy should certainly make an effort to prevent other officers of the service from being misled.

It is not likely that any medical officer of the Navy requires any further enlightenment with regard to resuscitation apparatus of the type referred to, but items which appear in the daily press from time to time seem to indicate that members of the medical profession in general are not so well posted as they should be regarding the application of the Schaeffer or prone pressure method of manual artificial respiration in cases of asphyxia resulting from electric shock, carbon-monoxide poisoning, or submersion in water, the adequacy of the method to save life where life can be saved, and the paramount importance of not unnecessarily wasting a single second before beginning artificial respiration.

The article quoted above shows that the facts may be quite different from the account printed, but the papers from time to time report accidents which do seem to indicate that hospitals equipped for the treatment of accident cases should see to it that ambulance surgeons and internists sent out on emergency calls are better informed than they appear to be, judging from newspaper accounts. For example, the news of the day one morning included an item relating to the drowning of a boy in a small body of water in a public park. It appeared that the boy was pulled out of the water by a passing motorist who evidently knew nothing about artificial respiration. A motor-cycle policeman joined the throng. It must have been that he, too, was ignorant, else he would have begun the prone pressure method, but it appears that he sent in a call for an ambulance which arrived in due time. One would hope at this point to read that artificial respiration was begun immediately in spite of the probability that the critical moment after which no treatment could possibly save life had already passed. But not so; it appears that the boy's body was placed in the ambulance and rushed to the hospital, a distance of several miles, where upon arrival he was pronounced dead.

A CASE OF GONOCOCCUS INFECTION OF CONJUNCTIVA ATTRIBUTED TO INFECTION BY A CONTAMINATED TOWEL

While chipping paint on board a destroyer a man got some particles in his eye. These were removed, the eye was irrigated with a solution of boric acid, and a drop of 10 per cent silvol solution was instilled. In the evening the eye was slightly inflamed and the treatment was repeated.

The following morning there was a profuse purulent discharge. Examination of the pus revealed intracellular Gram negative diplococci.

The man did not have gonorrhea and there was no evidence that he had had a venereal disease.

During the night he had placed his own towel wet with water over the affected eye. The medical officer ascertained that the man did not keep his locker locked, so it was possible for some one infected with gonorrhea to have borrowed the towel in his absence. The medical officer concluded that infection with gonococci took place during the night, because there was no discharge the evening before and the slight degree of irritation was consistent with the irritating effect of the particles of paint which had gotten into the eye in the forenoon.

WORN-OUT OIL FROM AUTOMOBILE CRANK CASES IN THE PREVENTION OF MOSQUITO BREEDING

According to a paragraph in the weekly Health News, published by the New York State Department of Health, October 19, 1925, the health officer of Mamaroneck states that oil drained from automobile crank cases, collected at garages and filling stations, has been used successfully in a mosquito-extermination campaign in that village and vicinity. Following its systematic application to stagnant ponds, pools, and catch basins, there was a marked reduction in the number of mosquitoes.

DEFECTS NOTED IN READING SANITARY REPORTS

Most sanitary reports which reach the bureau are satisfactory, but occasionally general statements are made where, if the item reported is to have any meaning at all or at least is to convey the impression that the medical officer is attending to any work besides inditing the sanitary report, definite and specific statements are required.

For example, the following appeared in a sanitary report from a small vessel: "*Bedding has been aired when practicable, and every effort has been made to exterminate bedbugs and roaches.*" How can

the reader know that the bedding was aired more than once? It would seem safe to conclude that the ship is having an unsatisfactory experience with bedbugs and cockroaches, but one might well be justified in doubting whether the words "every effort" can safely be taken to mean that practical measures are being effectively taken to rid the ship of vermin.

INFORMATION REQUIRED ON THE FORM F CARD WHENEVER AN OFFICER OR ENLISTED MAN CONSIDERED AS BELONGING TO FLIGHT PERSONNEL IS ADMITTED TO THE SICK LIST FOR ANY CAUSE

For various reasons it has become necessary to compile vital statistics specifically for aviation personnel in the Navy. This subject is covered in Bureau of Medicine and Surgery's Circular Letter, Serial No. 397, of June 26, 1925.

The purpose of this note is to remind all medical officers of the provisions and purpose of that letter and through them all hospital corpsmen who may be concerned in preparing Form F cards. Medical officers are requested upon reading this to make a suitable note for hospital corpsmen doing office work so that there will be no failure to state "Av-flight" or "Av-ground" on every Form F card notifying admission, readmission, or admission for contributory disease in the case of every individual who is considered by reason of his prescribed duties to be subjected to flight or other aviation hazards.

There should be no difficulty so far as flight hazards and flight personnel are concerned, and it should be possible to collect accurate statistics for flight personnel—general morbidity statistics, and mortality from all causes, as well as deaths from external causes and nonfatal accidental injuries. However, much will necessarily depend upon cooperation given by medical officers generally. Returns from naval air stations and vessels regularly carrying aviation personnel will be checked. The point especially to be guarded is the occasional admission of an individual belonging to flight personnel on board some other ship or at some station other than a naval air station where flight personnel are not regularly being admitted to the sick list. It may be added that the status of the deceased individual should likewise be indicated on Form N in case of death from disease or injury.

The term "ground personnel" has not hitherto been exactly defined for statistical purposes. There are undoubtedly certain special hazards which may properly be regarded as aviation hazards to which aviation personnel other than flight personnel are subjected, and doubtless in the future practical consideration will be given to these. Medical officers from their knowledge of the duties per-

formed by the individual or by means of sources of information available should, in practically all cases, be in a position to judge whether he is properly to be regarded as belonging to aviation ground personnel and as such exposed to aviation hazards to which naval personnel in general are not exposed.

Be that as it may, the inclusion of all personnel connected with aviation activities with the further separation into ground personnel and flight personnel serves to increase the probability that complete and accurate statistics for the latter will be collected, and that is the matter of first importance.

At present, for the purposes of vital statistics, aviation personnel may be defined as all officers and enlisted men of the Navy and Marine Corps who are performing duties in connection with the flying, construction, repair, upkeep, or handling of aircraft. Obviously, ground personnel include all who have any or all of these duties other than actual flying. Flight personnel include all who have orders requiring flight in aircraft from time to time, even though not engaged in the actual operation of the aircraft, as, for example, an aviation machinist's mate or radio operator with flight orders.

STATISTICS RELATIVE TO MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

The following tables were constructed with figures taken from monthly reports submitted by boards of review at naval training stations:

Cumulative data for January 1 to June 30, 1925

	Number	Per cent of recruits received	Per cent of recruits reviewed
All naval training stations:			
Recruits received during the month	5,889		
Recruits appearing before Board of Review	337	5.72	
Recruits recommended for inaptitude discharge	253	4.30	75.07
July-August-September, 1925			
United States naval training station, Hampton Roads, Va.:			
Recruits received during the months	131		
Recruits appearing before Board of Review	12	9.16	
Recruits recommended for inaptitude discharge	12	9.16	100.00
United States naval training station, Great Lakes, Ill.:			
Recruits received during the months	139		
Recruits appearing before Board of Review	19	13.67	
Recruits recommended for inaptitude discharge	11	7.91	57.89
United States naval training station, San Diego, Calif.:			
Recruits received during the months	229		
Recruits appearing before Board of Review	45	19.65	
Recruits recommended for inaptitude discharge	33	14.41	73.33
United States naval training station, Newport, R. I.:			
Recruits received during the months	187		
Recruits appearing before Board of Review	16	8.56	
Recruits recommended for inaptitude discharge	15	8.02	93.75

ADMISSIONS FOR INJURIES AND POISONING, JULY, 1925

The following table indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during July, 1925, is based upon reports reaching the bureau prior to October 10, 1925:

	Admissions, July, 1925	Admission rate per 100,000 per annum, July, 1925	Admission rate per 100,000, year, 1924
INJURIES			
Connected with work or drill	335	3,493	3,148
Occurring within command but not associated with work	211	2,200	1,705
Incurred on leave or liberty, or while absent without leave	99	1,032	1,004
All injuries	645	6,725	5,857
POISONING			
Industrial poisoning	2	21	21
Occurring within command but not connected with work	8	83	128
Associated with leave, liberty, or absence without leave	0	0	126
Poisoning, all forms	10	104	175
Total, injuries and poisoning	655	6,829	6,032

PERCENTAGE RELATIONSHIPS

	Occurring within command				Occurring outside command	
	Connected with the performance or work, drill, etc.		Not connected with work or prescribed duty		Leave, liberty, or a. w. o. l.	
	July, 1925	Year, 1924	July, 1925	Year, 1924	July, 1925	Year, 1924
Per cent of all injuries	51.9	53.7	32.7	29.1	15.4	17.2
Per cent of poisonings	20.0	12.1	80.0	73.4	0	14.5
Per cent of total admissions, injury and poisoning titles	51.5	52.5	33.4	30.4	15.1	17.1

Poisoning by a narcotic drug or by ethyl alcohol is recorded under the title "Drug addiction" or "Alcoholism," as the case may be. Such cases are not included in the above figures.

The following cases selected from July reports are worthy of notice from the standpoint of accident prevention:

Lack of adequate gangway guard rails or safety lines on a destroyer.—A chief petty officer fell from the gangway and was drowned.

Faulty steam-pressure-regulating device on a steam-jacketed copper kettle.—Failure of the steam-regulating device caused an explosion of steam in a steam kettle in a ship's galley. One man received burns of the back and arms. He was on the sick list 11 days.

Lack of safety device on a bread cutting machine.—Amputation of a little finger was the injury in this case. Bread-cutting machines have caused a considerable number of injuries during the past

year. The hazards connected with cutting machines, mixing machines, and other equipment of galleys and bakeries should be well know to the men using them. Consequently, the question arises in case of accident whether to attribute injury to intrinsic hazards or to fault of the person injured and in some cases perhaps to negligence of other persons.

Gasoline leak in a motor boat.—Gasoline accumulated in the bilge and an explosion occurred, the gasoline vapor being ignited by a spark caused by backfire of the motor. One member of the crew was burned about the hands and face and was treated on the sick list for 21 days.

Unsafe practice.—A coxswain who was standing guard with a pyrene fire extinguisher, turned it up, looked at the business end, and at the same time pulled the pump handle. His injury was described as a chemical burn of the eye.

Careless operation of a food chopper.—A helper turned the handle of the machine while the injured man's fingers were in it. The injury consisted of fractures of two fingers, which incapacitated the man for 35 days.

These are all the cases noted among reports of admissions for injuries and poisonings in the month of July that can be regarded as examples of obviously preventable accidents. It is possible that in certain other cases negligence factors or faults of matériel might have come under consideration with more complete knowledge of the circumstances and conditions involved. However that may be, it is of interest to mention that a few months ago it was not difficult to select 30 or more examples of clearly preventable accidents from the Form F cards received in the Bureau of Medicine and Surgery during the month. The proportion of such cases has progressively dwindled, and now careful search can hardly be expected to reveal 10 such cases. This may not prove true of the morbidity reports received in future months but at any rate it will be interesting to watch the trend of events.

HEALTH OF THE NAVY

This report is for the month of November. Good health conditions which prevailed through the autumn continued throughout November. The incidence of acute respiratory diseases was low.

Only five cases of mumps and one case of measles were reported during the month. No case of diphtheria or scarlet fever was notified by any naval station in the United States or by any naval vessel. Ashore and afloat only 26 cases of influenza were notified.

It is gratifying to note that monthly reports of communicable diseases and general morbidity were received more promptly than

hitherto. Reports were received in time for use in preparing this summary from 98 per cent of the ships comprising the Scouting Fleet and from 88 per cent of those listed as belonging to the Battle Fleet.

The following table shows provisional admission rates per 1,000 per annum, entire Navy, for the principal communicable diseases for September, 1925, together with corresponding median rates for the same month, 1920 to 1924, inclusive:

	September, 1920-1924	September, 1925
Cerebrospinal fever	0	0.21
Diphtheria	.27	0
German measles	.38	0
Influenza	10.71	7.48
Malaria	8.61	6.30
Measles	.38	1.92
Mumps	1.24	3.84
Pneumonia	2.34	.64
Scarlet fever	.61	.21
Smallpox	0	0
Tuberculosis (all forms)	2.48	.53
Typhoid fever	.10	.11

TABLE No. 1.—*Summary of morbidity in the United States Navy and Marine Corps for the month of September, 1925*

	Forces afloat	Forces ashore	Marine Corps	Entire Navy
Average strength	74,339	38,012	19,152	112,351
All causes:				
Number of admissions	2,707	1,788	835	4,495
Annual rate per 1,000	436.97	564.44	523.18	480.07
Disease only:				
Number of admissions	2,259	1,449	720	3,708
Annual rate per 1,000	364.68	457.42	451.13	396.01
Communicable diseases, exclusive of venereal diseases:				
Number of admissions	576	435	224	1,011
Annual rate per 1,000	92.98	105.76	140.34	107.98
Venereal diseases:				
Number of admissions	905	253	152	1,158
Annual rate per 1,000	146.09	48.30	95.24	123.67
Injuries:				
Number of admissions	394	248	110	642
Annual rate per 1,000	63.60	78.29	68.92	68.57
Poisoning:				
Number of admissions	54	91	5	145
Annual rate per 1,000	8.72	28.73	3.13	15.49

TABLE No. 2.—*Deaths reported, entire Navy, for the month of November, 1925*

	Navy (strength, 93,199)	Marine Corps (strength, 19,152)	Total (strength, 112,351)
Cerebrospinal fever	1	0	1
Tuberculosis, chronic pulmonary	1	0	1
Other diseases	1	0	1
Drowning	6	1	7
Other accidents and injuries	5	7	12
Total	14	8	22
Annual death rate per 1,000, all causes	1.80	5.01	2.35
Annual death rate per 1,000, disease only	.39	0	.32

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SPECIAL ARTICLES

MEDICAL TACTICS IN NAVAL WARFARE

By W. L. MANN, Lieutenant Commander, Medical Corps, United States Navy

In view of the rather extensive array of facts presented in a somewhat condensed form, it is deemed advisable—instead of following the usual custom of placing a summary at the end—to present an outline of the fundamentals at the beginning of this article.

This arrangement, permitting the reader to become conversant with the basic ideas before considering the discussion of the details, should serve to facilitate gaining a more thorough understanding of the proper relation of the points subsequently elaborated.

SYNOPSIS

The mission of a military medical service is the promotion of physical efficiency for combat—by (*a*) proper procurement and (*b*) conservation of physical power.

The fundamental principles of war may be roughly expressed as the concentration of a superior force against a vulnerable portion of the enemy; and, secondarily, the use of a minor force to contain or delay a superior force.

PART I

MEDICAL TACTICS OF COMBATANT SHIPS

HISTORICAL

The early " fighting post " of the ship's surgeon was situated below the water line in the compartment known as the " cockpit."

With the development of steam power this space was taken up and used for machinery.

The battle of Lissa demonstrated the large number of casualties from drowning caused by the rapid sinking of ironclads.

The results of naval engagements in the Chile-Peruvian and Chino-Japanese wars showed the necessity for returning the action stations of the medical departments to protected locations below the water line.

The naval engagements of the World War confirmed previously accepted principles of medical tactics and demonstrated the need of ships equipped to operate as rescue ships in a naval engagement.

Estimates of normal sick and injured

Average daily percentage	0.80
Average daily percentage of complements of capital ships transferred to hospital and hospital ships	0.04
Average daily percentage of complements of capital ships under treatment in hospitals (including hospital ships)	1.33
Average daily percentage of complements of capital ships carried on the sick list under conditions where supporting hospital facilities are not available	2.13
Ratio of the average daily number transferred to hospitals to the average daily number of patients carried on sick lists of capital ships	1 to 19
Ratio of injury to diseases	1 to 9

Battle casualty estimates

The difference in the casualty percentages of a superior and inferior naval force, respectively, is apt to be out of all proportion to their fighting power.

Force casualty rate (including drowning)	20 per cent.
Force wounded rate	10 per cent.
Force death rate (including drowning)	10 per cent.
Force ratio of killed to wounded	1 to 1.
Maximum casualty rate for individual ship	40 per cent.
Maximum wounded rate for lighter vessels	20 per cent.
Maximum wounded rate for capital ships	15 per cent.

Prevention of personnel losses.—Protection against shell fragments and splinters.

Protection against gases of explosion and other chemical gases.

Measures taken to reduce losses from drowning.

Antiflash protection and defense against burning powder and other inflammables.

Basic Principles of Medical Tactics on Board Combatant Ships

1. To insure the services of medical personnel after action, their disposition in two or more sheltered positions during action is required.

2. Conservation of medical and surgical supplies and equipment is secured by distribution to two or more protected situations.

3. Relative immobility is imposed upon the medical department during action as a corollary of the principle of conservation. This inactivity is also caused by the interrupted lines of communication between the medical station and the "firing line," rendering medical efforts to aid the wounded more or less futile during action.

4. Medical action stations must be provided at the time of constructing warships.

5. First aid must be administered, in the majority of cases, by lay members of the crew.

6. For satisfactory application of first-aid measures, systematic instruction by divisional officers to the crew, with specialized instruction by medical officers to selected members, is essential.

7. Manual transportation is more expeditious, as a general rule, than by the use of litters.

8. Canvas chutes or slideways between decks are of proved value.

9. Medical plans for action must include the establishment of a post-combat hospital, in lieu of the facilities of a hospital ship.

10. It is impracticable to carry sufficient medical personnel to meet satisfactorily all the requirements following a major engagement and —as a corollary—assistance from other branches of the naval service on board ship is demanded.

11. The preceding statement is applicable—though in a less degree—to medical and hospital matériel.

12. Military and humanitarian considerations require the early removal of battle casualties from fighting vessels.

Tactics of type ships:

1. *Capital ships*—

   Establish three medical action stations.

   Prepare for a large percentage of burns.

   Hemorrhage is apt to be slightly less common than on other types of ships.

2. *Light cruisers*—

   Establish two action stations.

   Burns are relatively rare.

   The large majority of wounded will be found on upper decks.

   The accounts of the battle of Jutland show that there was difficulty in hitting light cruisers and destroyers in a daylight action. Over 50 salvos were fired at the *Wiesbaden*—lying dead in the water—yet she survived until 7 p. m. Not a hit was made by the several German battleships firing, for nearly one hour, at the Second Light Cruiser Squadron.

3. *Destroyers*—

   Protective locations for medical stations below the water line are not available.

   Collection and care of the wounded are more difficult.

   Burns are practically absent; scalds from exposed steam pipes disrupted by shell fire may occur.

In subsequent issues of this publication the tactical employment of hospital ships and shore hospitals in naval warfare, and medical tactics of landing parties, will be considered.

INTRODUCTION

The Navy exists primarily for use in war—a comprehensive but true statement.

"First and above all the Navy's duty in peace is to prepare and maintain itself in instant readiness for war" (1).

From this it follows that the naval medical department—as well as the other components of the naval service—must direct its peace-time activities in the direction which will best lend support and assistance to the various naval units in attaining their prospective war-time objectives.

The highest efficiency of a naval medical service consists in "maintaining a general condition of preparedness sufficiently elastic and flexible to meet in the best possible manner the exigencies of battle which are likely to arise."[1]

As a means to such efficiency no subject contributes more than medical tactics. "Medical tactics may be defined as the art of handling medical troops in campaign in such a way as to best serve the troops to which they are attached. It is based on the tactics of the troops to which they are attached" (2).

Naval medical tactics comprehends, in a very broad sense, the development and employment of all the means and measures which may properly be utilized by a naval medical detachment in assisting the organization of which it is a component in carrying out its war-time mission. It refers, particularly aboard combatant ships, to the use of the medical agencies for this purpose immediately prior to, during, and directly after contact with an enemy.

This definition of medical tactics is considerably more comprehensive than the one used by combatant branches, as it is extended to include the *preparation* of the medical department for battle.

From the viewpoint of line organizations *strategy* constitutes the preparation for, or conception of, battle, while *tactics* is the execution.

Strategy (stratagem) implies the use of a certain amount of cunning, artifice, ruse, or even subterfuge, all of which are permissible

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[1] It will be quite evident that many of the ideas here presented were obtained from sources other than original. To present the specific authority for each detail or opinion is manifestly impracticable.

In the list of references will be found the articles studied for the preparation of this paper, and the subjects of these articles afford a good indication of the type of information abstracted.

in warfare. These qualities are more or less foreign to the activities of a military medical department, hence it appears advisable to avoid the use of "medical strategy" by enlarging the scope of medical tactics and employing the term "medical preparedness" to comprehend the remaining medical activities of war time.

The words "development and employment" signify that medical tactics is herein considered both an art and a science. As a science it must ascertain, investigate, and correlate observed facts; formulate laws; and develop its principles and agencies. As an art it makes practical use of this information.

The principles governing the conduct of the medical department in action at sea is also a timely subject for consideration, as sufficient time has elapsed since the termination of the World War to permit definite conclusions to crystallize from the flux of opinions, inevitable in war. While the records at my disposal of the observations and conclusions of the medical personnel actively participating in these naval battles are somewhat limited and perhaps fragmentary, yet there is such unanimity on major points prevailing among independent observers that the acceptance of these views as authoritative and final is warranted.

It may be argued, and properly, that naval medicine, in an overzealous attempt to contribute to the success of the fighting forces, may transgress the laws of international warfare, which specifically prescribe limitations to medical activities. This possibility must be kept constantly in mind. The military aid contributed during and after a naval engagement by a medical detachment is largely one of negation—denying the enemy the advantage by rendering futile his efforts to cause greater personnel losses to our own side—with a superimposed and humanitarian task of succoring the casualties of our adversary, whenever the military exigencies permit.

"For success in war, it is necessary that every detail be the subject of much study and every need be foreseen in time of peace" (3).

Unfortunately, the great amount of energy and effort required of medical officers in the solution of the numerous routine professional problems of peace pursuits, and, at the same time, endeavoring to keep abreast the ever-growing profession of modern medicine, unduly restricts the time available for the study of theoretical medical problems of war and thus often leads to failure to perceive clearly our objective. In view of this, advantage has been taken of the present opportunity of access to several sources of information—such as sanitary reports, official communications, medico-military periodicals and treatises, etc.—to make an analytical study of the data from these sources for the purpose of outlining the new principles of medical tactics derived from the lessons of the World War.

Although the results of this study lead to no striking discovery or conclusion, yet it is hoped that some points in this assembly of data may be helpful in suggesting an occasional idea which will aid in further developing the details of the present system of medical tactics so comprehensively outlined in the Manual of the Medical Department, United States Navy, 1922.

It would appear, however, that no fundamental changes in naval medical organization are justified from analysis of the information at my disposal. Stitt (4) says "the lessons drawn from the World War tend, however, more to the confirmation of previously accepted doctrines governing methods of handling wounded than to the establishment of any radically new principles."

But why develop the details for conduct of the medical department in battle when the new methods and weapons of naval warfare are constantly changing the type of tactics of the medical department and it is impossible accurately to anticipate all the combinations of circumstances influencing the conditions of battle?

This question involves the "fallacy of finality"; there is no finality in plans for battle. (In fact, progress in any activity postulates a state of mutation.) Such plans must be based upon the latest information of current conditions, which are in a state of continuous flow, and this necessitates continual revision of plans for action.

The principal sources of data for the establishment of the broad principles underlying a science are the observed facts and recorded experiences of others. This is true of the science of naval medicine.

In order to formulate principles for our future guidance in naval action, a careful study of the various experiences and opinions recorded in literature is manifestly essential. The collection and compilation of some of this data constitutes the primary purpose of this article.

An endeavor has been made to correlate the existing data, to formulate deductions where they were obvious, and to present divergent views without comment when authorities fail to agree.

A few introductory and explanatory remarks will perhaps give a clearer conception of some of the points involved in the subsequent discussion, and at the same time show that practically our entire peace-time activities are directed toward the attainment of a common objective of maintaining the personnel of the Navy in a fit physical condition for war.

Naval medicine is considered one of the branches of modern medicine and is partially dominated by its teaching. Like many of the other modern sciences, it is also guided and controlled by an auxiliary science—the science of naval warfare.

It will be seen that the principles of naval medicine are based upon two sciences, and the development of its principles is the resultant of the two influences. If the teaching of medicine should come in direct conflict with the principles of naval warfare, the auxiliary profession—"military necessity"—would usually assume the supremacy.

In other words, the science of medicine must be adapted to naval conditions for the primary purpose of prevention of losses of personnel. For this purpose, naval medical officers must investigate and formulate their own principles of conduct, which creates an interesting field for research and study in a modern science still in its formative state.

In approaching the subject, one is naturally compelled to ask what the naval service desires of us, and this inquiry leads to a consideration of the mission of a naval medical department—its proper action in relation to the Navy as a whole. For what purpose does the medical service exist? What objective does it strive to attain? What task is assigned to it?

The following are some methods of expressing the *mission* of a military medical service:

To conserve physical power.
To promote physical efficiency for combat (5).
To maintain the supply of fighting men for the firing line (Dunbar) (6).
To prevent any avoidable loss in personnel or diminution in its effectiveness. (Anonymous.)

The above may be considered the war mission. The peace-time mission of the medical department is almost identical and may be stated as follows:

To maintain a state of readiness which will best facilitate the successful attainment of its war-time objective.

Farenholt (7) expresses the surgeon's primary duty on board ship as—

(1) Keeping the health of the personnel up to the highest state of efficiency.

(2) Arranging for the care of the wounded in, and more particularly immediately after, action.

According to Stephens (8) the first duty of the surgeon of the ship is "to render the ship an efficient fighting unit as far as lies in his power."

To again resort to military parlance, our "decisions," or the means we adopt to accomplish our mission, may be summarized under the following categories which comprehend nearly every phase of naval medical activity—in peace or war.

(*a*) *Procurement* of man power—recruiting.

(*b*) *Promotion* of physical power—augmentation of health by hygienic measures.

(*c*) *Prevention* of diminution of physical efficiency—sanitation.

(*d*) *Restoration* of physical power—treatment of disease and injuries—hospitalization, including procurement and distribution of medical and surgical supplies and equipment.

(*e*) *Separation* from fighting forces of physical ineffectives—evacuation of disabled (primarily a war-time measure).

FUNDAMENTAL TACTICAL PRINCIPLES

Medical tactics in warfare at sea constitutes one of the components of—and is based upon—naval tactics; hence for an intelligent formulation of medical plans for action a knowledge of the fundamental principles of naval warfare is essential.

"The medical department serves the line in campaign as part of the military team. In order to function intelligently it must adapt itself to the conditions created by line tactics and operations; therefore those who serve as part of medical units must have at least a good working knowledge of line tactics. Otherwise good teamwork is very difficult" (2).

To discuss line tactics is beyond the scope of this article and the ability of the writer; books, however, treating of naval art and science are usually available and should prove interesting and profitable collateral reading for medical officers in their moments of leisure. The first three parts of Stirling's book, "Fundamentals of Naval Service," (1), are most suitable for this purpose, with especial reference to the tactics of type ships, as is also "War on the Sea" by Darrieus and Daveluy (9).

The fundamental principles of Higher Tactics—also termed the "Principles of War"—have been classified as follows:

A. Principal objective.
B. Economy of force.
C. The mass.
D. The tactical offensive.
E. Rapidity or economy of direction.
F. Security.
G. Surprise.
H. Simplicity.
I. Cooperation.

"My greatest successes have been attributed to luck, and my reverses to my faults, but if I wrote my campaigns one would be very astonished to see that in every case I exercised my faculties in order

to conform to the principles of war." (Napoleon's conversation at St. Helena, November 16, 1816.)

"If a good theory, founded on true principles, justified on facts and justified on history, will not invariably make good men—for good men make themselves when favored by circumstances—it makes at least chiefs who are sufficiently able to be perfectly in their place in the second rank under the orders of great generals." (Jomini.)

These fundamental tactical principles are deducible from an "analytical study of war," and, as a rule, they are applicable to war in general, whether on the sea, land, or in the air; but there are slight variations distinguishable in the application of the fundamental tactical principles to land and naval warfare. In military operations on land there is a greater tendency to utilize a reserve force, while in battles at sea a relatively greater amount of the available force can be brought to bear simultaneously. This is because at one time the mutual support of the military elements could be more advantageously used in land warfare than in sea warfare, although Nelson, in one of his battles, departed somewhat from this principle of mutual support by giving his subordinate commanders more power of exercising initiative, the independence so granted being one of the factors that enabled him to be victorious over his adversary, Villeneuve, who had asserted that he rigorously relied upon "mutual support."

At present, however, the specialization of modern naval vessels into distinctive types gives this principle of mutual support—cooperation—more prominence than in the days when fleets were composed of more or less homogeneous types of ships.

As an aid to remembering what constitutes the "Principles of War," it may be stated that Gen. Nathan Bedford Forrest—the noted Confederate cavalryman whom General Sherman considered the most "remarkable man the Civil War produced on either side"—when requested to explain the secret of his successes in battle, is said to have replied: "Getting there fustest with the mostest."

Upon reflection, this reply appears to embody in a terse epigram all the fundamental principles of Higher Tactics, the word "there" conveying to the mind the principle of "The Principal Objective," "fustest" implying speed in movement, or celerity of action, and the principles of Economy of Force, and the Mass, being comprehended under the word "mostest"; while the tenor and spirit of the entire epigram—"getting there fustest with the mostest"—implies Surprise, Security, and Initiative, as well as that the general always endeavored to assume the Tactical Offensive. In other words, "Attack the enemy's weakest point with the greatest possible numbers." (Napoleon.)

Identically the same principle is involved in the combats of individuals, whether it be the heel of Achilles, or the angle of the jaw or solar plexus of the prize fighter, that forms the vulnerable point of contact for the reception of the maximum possible concentration of the offensive force of the opponent.

It may not be too much of a digression to pause and consider what the terms "tactics" and "strategy" actually signify.

The term "tactics" has been variously defined, many of the definitions endeavoring to differentiate tactics from strategy. Strategy, however, permeates tactics, and, in fact, the line of cleavage between tactics and strategy is often indistinct, as the two may coexist both in time and in place.

However, for a theoretical consideration of this topic it is advisable to assume an artificial boundary and confine both tactics and strategy to their proper sphere of influence as here defined.

The definition of tactics contained in the United States Naval Instructions, 1913, article 535, answers this purpose admirably, and is quoted as follows:

"Strategy applies to the distribution of naval forces, their armament and supplies in preparation for war or in the prosecution of war. It includes logistics. It refers to naval movements and dispositions made before contact with the enemy's forces."

"Tactics applies to all naval movements and operations made after contact with the enemy's forces. The term 'contact' is here employed in a broad sense, meaning such proximity to the enemy as affects fleet formation and renders a battle imminent."

Tactics is "the art of leading troops in battle"; strategy is the "art of bringing the enemy to battle on terms disadvantageous to him."

Tactics is the *execution* and strategy is the *conception*.

Tactics is the "use of ships in battle"; strategy is the "use of battles in war."

One writer makes a rather clear differentiation of these terms by comparing war to a theatrical performance. Strategy corresponds to the *plot* of the play, tactics is likened to the *rôle* of the players, while logistics would include the *costumes*, *scenic effects*, and the like.

This comparison recognizes the coexistence of strategy and tactics, and at the same time it postulates the *dominating preexistence* of strategy.

Naval medical tactics is divisible into and will be discussed under the following captions:

Part I. Medical tactics on board combatant ships.

Part II. Tactics of (*a*) hospital ships and (*b*) shore hospitals.

Part III. Medical tactics of amphibious operations.

PART ONE

MEDICAL TACTICS ON BOARD COMBATANT SHIPS*

Evolution and Development of Medical Tactics Aboard Combatant Ships

The first record in history of a distinct medical organization on board naval vessels was during the days of the Roman Empire. Each trireme carried a naval medical officer who received double pay, apparently as a necessary means of inducing men to enter upon that arduous type of duty, for there exist epitaphs of three of these surgeons serving on the triremes, Cupid, Faith, and Tiger, and opposite the name of each is the word "duplicarius," indicating that he received double compensation. This word is never found after the names of any of the medical officers attached to the land forces, suggesting that the Roman Army was the more popular service for physicians.

The accounts of the ancient naval medical department show that the medical preparation for battle was meager, as we read of Cæsar, before the naval engagement at Actium, directing his senior medical officer to prepare only for victory, and to make no provision for the care of the enemy's wounded—"those who escape the sea must fall by the sword."

Vinegar and wine were used by the Romans as preventives of and remedies for disease due to dietetic deficiency (10). From this it seems reasonable to infer that *panis nauticus*, referred to by Pliny, was a food probably developed by the naval medical service for the prevention of these disorders so prevalent in those days on board ship. As evidence of this, it may be added that Roman naval and military medical officers were, as a general rule, of Greek origin and were familiar with a special baked bread used as a ration for Greek soldiers.

With the decline of Rome, naval medical organizations practically disappeared. During the Middle Ages we find there was no distinct naval medical organization, the fighting force of ships being composed of soldiers, the commanders of which carried their own medical officers afield or afloat as the occasions demanded. If there was a surgeon, he was likely to be the ship's barber.

William Clowes, some time naval surgeon, writing in 1596, says that there are "many worthy men, but also many scamps," in the naval medical service. In those times the naval surgeons were "pressed" men, i. e., men forcibly induced and compelled to serve in the naval service.

It appears that the entire medical service of the British navy was controlled by the company of barber-surgeons of London. In a

letter, dated March 23, 1635, from the Navy Office to the Admiralty, the following is found:

"The fleet is now drawing and ready to goe to sea, we have according to ancient custom given orders to Masters and Warders of the Barber-Chyrurgeons to press chyrurgeons and for all the ships of the first fleet, and have given them charge to cause them to appear before us, att the meeting House in Mincing Lane, on Fryday in the afternoon, the 1st of Aprill." (See Guy's Hospital Gazette, 17:333, August 1, 1903.)

Until the latter part of the nineteenth century, the cockpit was the scene of the medical department activity during battle. Several vivid and gruesome pictures of scenes enacted there have been left to us.

Commander J. T. Kennedy, Medical Corps, United States Navy, in an unpublished paper, has described the cockpit as follows:

"In the afterpart of the ship below the water line was a space known as the cockpit. In it lived the senior midshipmen, the surgeon's mates, the master's mates, and civilians, like the clerk for the captain and purser. Below was the hold, a dark noisome apartment filled with foul odors, and above was the gun deck, a place of noise and excitement in action, from whose leaky seams dripped the blood and water of carnage on the operators below. The berths of the midshipmen were converted into receptacles for the wounded by laying a sail over them, and the mess table in the center became the operating table of the surgeon. This protected space survived the changes in subsequent naval architecture through the following centuries, and in just such a similar dungeon, surrounded by his wounded shipmates, the great Nelson died in the arms of his favorite surgeon toward the end of the era of fights under sail.

"Smollet, who served in the navy as a surgeon's mate before taking up literature, gives us a vivid description of an action in those days which, allowing for the natural exaggeration of literary genius, may be considered as a faithful picture of surgeons of those ships and of their professional abilities.

"'The head surgeon arose from the deck where he had been engaged in making his peace with God, strengthened his resolution with a huge drink of rum, which he insisted on sharing with his civilian assistants, the chaplain and the purser, and then went to work hewing off arms and legs without sense or mercy. The fires of delirium arising from the fumes of the rum, maddened the chaplain, who stripped himself of his few garments, smeared his body with blood, and was withheld from running on deck only by the well-placed blow of a seaman whose left hand had just been shot away.

"'The purser sat on the deck with his head in his hands cursing the hour he deserted his peaceful profession of a brewer to engage in this life of terror and disquiet. He, too, becoming violent from liquor, was locked in the adjacent stateroom of the surgeon's mate, where his howls added to the horror of the din overhead.

"'While we worked at our task with shirt sleeves tucked up to our armpits and hands dyed in blood, the gun deck above an inferno of smoke, noise, and slaughter, wounded men dropping with dull thuds on the benches prepared for them and shrieking, moaning, or whining for assistance, a shot entered the cockpit and crashed into the purser's storeroom, making such a wreckage and state of terror the surgeon again abandoned his ruthless mutilation and dropped to his knees in prayer.'"

The cockpit fulfilled some of the fundamental requirements of a suitable location for the activities of the medical department. It was centrally located, to a degree accessible, and assured the medical personnel of reasonable protection from the hazards of battle by its position below the water line of the ship.

With the change from sail to steam, the space previously taken up by the cockpit and used for the care of the wounded was demanded for the engine room and coal bunkers. This necessitated a change in the location of the medical department during action, and the most suitable situation remained to be decided by actual experience, which is always a hard taskmaster.

The first conflict between fleets of steel ships—battle of Lissa fought in the transitional period of the change from wood to steel—evidently failed to demonstrate any new ideas in medical formations on board ship.

In the naval battle of October 8, 1879, the wounded of the Peruvian man-of-war *Huascar* were collected in the wardroom, where many were subsequently killed by a broadside salvo from the Chilean ship *Blanco*. The wounded were later removed from this exposed location to a protected position in the storerooms and spaces adjacent to coal bunkers (11).

It would appear that this unfortunate experience of collecting the wounded in an exposed space failed to teach any important lessons to those charged with the responsibility of preparing medical departments for battles at sea, as we find, some 15 years later, that the wardrooms were utilized for a medical action station in the next naval battle of any size.

In fact it required the deplorable condition of the wounded aboard the Japanese ships after the battle in the Yalu Sea—September 16, 1894—to compel recognition and acceptance of certain fundamental principles of medical tactics aboard modern fighting ships.

The Japanese ship *Matsushima*, during this engagement, was struck by a 26-centimeter shell discharged from the Chinese ship *Ping Yuen*. "The greater part of surgical articles were destroyed by this shell" and the remainder scattered. Eventually the second surgery was destroyed. The ship's surgeon, M. Kusana, was forced to use a combination of engine oil and lime as an application for burns, and to improvise dressing material (12).

The medical department of the *Hiyei* suffered even worse from the effects of the damage caused by the enemy, as the surgery, which was located in the wardroom, was utterly destroyed and the entire medical personnel was either killed or seriously wounded by a 30.5-centimeter shell, which fell in the wardroom, causing 40 casualties (12). The suffering wounded were temporarily dependent for their treatment upon three able seamen detailed for this purpose, until the following day, when additional medical officers were ordered aboard as replacement for those killed in action. The wretched condition of the wounded for want of medical attention and supplies can easily be pictured.

The lessons of this battle established the principles of—

(*a*) The conservation of medical personnel in action;

(*b*) The necessity for protection of medical supplies and equipment from damage during battle; and

(*c*) The value of planning upon two or more completely equipped medical stations in order to avoid a "wholesale catastrophe" to the medical department such as was experienced in the *Hiyei*.

The casualties aboard our ships in the Spanish-American War were too few for us to derive any valuable lessons from this conflict. Conditions on the Spanish ships are described in the subjoined quotation taken from an article written by Capt. Victor M. Concas y Palau, formerly captain of the *Infanta Maria Teresa*, and chief of staff of the Spanish squadron in the naval battle of Santiago de Cuba. ("The Squadron of Admiral Cervera," translated from Spanish by Office of Naval Intelligence.)

"The operating room: (i. e., the battle dressing station). There is nothing more awe-inspiring and horrible than the operating room on board ship on the day of a battle. It required the whole extent of my authority, when I was carried down to it, to impose the order and silence which the valiant Ensign Ramon Rodriquez Navarro, who was down there in charge of the ammunition hoists, was trying in vain to enjoin. The wounded in all the ships refused to be taken to the operating room because of its being so difficult to get out of; they feared the most horrible death. On the *Vizcaya* some of the wounded had to be installed in the battery, with no other protection than that afforded by the turret; they did not

suffer much in this spot, thanks to the fact that the bow remained comparatively free from injury. On the *Oquendo* they were installed on the orlop deck, and some of the dying men were left there when the ship filled with smoke. On the *Teresa* they were installed on the forward platform under the protective deck, but near the pumps and ammunition hoists, thanks to which circumstance and to the valor of the surgeons and the officer above referred to, only dead bodies were left below. In any event it is imperative to consider a question which has so much influence on the morale of the crew. The operating room should have a large hatch with a good ladder through which the wounded can be lowered without difficulty, which would at least inspire them with a hope of safety. If the operating room could be located on the protective deck of protected ships, in a space that could be easily converted even though intended for other purposes, the measure would no doubt be of great moral influence; for it is certain that, except during bombardments and cases which can not be designated as naval battles proper, the wounded will rather incur the risk of new wounds than to be buried without being able to move in that place where even those who are accustomed to live in those holes feel ill at ease in time of peace and in the full enjoyment of their health" (13).

The Russians were the first to construct ships with specially designed dressing stations behind armor—the first ship so constructed with "l'hospital de combat" was completed in 1903—but it fell to the lot of the Japanese to test fully the system of medical tactics evolved from their experience in the war with China, they believing that the excellent results obtained in handling the wounded of the Russo-Japanese War amply repaid the energy and effort required in the elaboration of the new system of medical tactics and training of medical personnel.

The World War failed to present any outstanding developments in the fundamental principles of medical tactics on board ship. The lessons derived from the study of this conflict tend more to show improvements in the technique of previously established methods of handling wounded.

Development of Medical Tactics in the United States Navy

The American Navy with its medical corps appear to have had its embryonic origin in the colony of Virginia, where it was first developed as a distinct arm of national defense. This organization was sanctioned by the royal authority of Great Britain.

Later, the colonists of Virginia—foreseeing the coming struggle with the mother country—in May, 1776, proceeded to form plans for creating a naval force by arming 70 vessels of the merchant marine.

These vessels had been constructed at the Chickahominy Navy Yard, near Norfolk, Va.

Among the naval surgeons commissioned for this service were Doctors Balfour, Kemp, Lyon, McClurg, Brockenbrough, Christie, Reynolds, Sharpless, Pell, and others (14).

The information available on the conduct of the medical department of the Continental Navy in battle is rather limited.

The medical staff serving under John Paul Jones on the *Bon Homme Richard* consisted of Lawrence Brooks, from New Hampshire, as senior surgeon, and Surgeon's Mates Elijah Perkins, of England, and John Peacock, of Ireland, indicating the cosmopolitan nature of the crew.

It appears that the Continental medical officers were familiar with a type of chemical warfare as a naval weapon. The brig *Defiance* was equipped with 20 earthen jars, filled with a mixture of decayed fish, asafetida, saltpeter, and brimstone, prepared with a wick, called an oxtail. When lighted, the gas-producing apparatus gave off nauseating and suffocating fumes—presumably nonlethal, yet effective in overcoming the enemy.

While on the subject of the early use of chemicals in naval warfare, it may be mentioned that the Confederates in the American Civil War planned to capture the *Monitor* by throwing balls of stinking combustibles below decks and compelling the crew to abandon ship. Needless to state, these plans failed to materialize.

Among some of the members of the medical department of the United States Navy of the 1814 period, the following—arranged in order of seniority—may be mentioned:

Edward Cutbush.
Joseph G. L. Hunt.
Jonathan Cowdery.
Samuel D. Heap.
Samuel R. Trevett, jr.
William P. C. Barton.
Joseph Scholfield.
Thomas Harris.
Charles Cotton.
Richard C. Edgar.
Usher Parsons.
William Swift.
John Wise (surgeon's mate).

The naval medical service then consisted of 49 surgeons and 53 surgeon's mates.

The records of the naval battles during the War of 1812 contain some rather interesting accounts of the functioning of the medical department during naval engagements.

In the fight between the *Chesapeake* and the *Shannon* on June 1, 1813, Surg. Richard Edgar, while treating the wounded in the battle dressing station located in the cockpit, was ordered by Captain Lawrence—who had been wounded—to go on deck and tell them "to fight the ship till she sinks." Lawrence later countermanded

the order and Surgeon's Mate John Dix was ordered to go on deck and tell the "men to fire faster and *not to give up the ship*," but the enemy's fire on the berth deck prevented him from delivering the message now famous in the annals of naval history.

It seems that the arrangements on this vessel for transportation of the wounded to the medical action station were most meager. The hatches leading to the cockpit were congested with wounded as stated in the record of the court-martial in the case of Lieut. William S. Cox, who was found guilty of unofficerlike conduct in leaving his battle station in face of the enemy for the purpose of conveying Captain Lawrence below for medical treatment. The sentence was "to be cashiered with a perpetual incapacity to serve in the Navy of the United States. Sgn. Stephen Decatur, President; Tho. O. Selfridge, Judge Advocate."

The seriousness of combatant forces leaving their action station for transfering the wounded appears to have been well recognized in those days, and it is questionable whether the personnel of modern vessels is thoroughly aware of the military importance of the absolute enforcement of this principle of medical tactics.

At the Battle of Lake Erie, the only American medical officer on duty, the other two being ill, was assigned a detail of six men to assist in handling the wounded, but as the battle progressed these medical aids were recalled one by one to help man the guns. The battle dressing station on the *Lawrence* was in the wardroom and above the water line, because of the small draft of the ship affording no cockpit. This arrangement must have given slight security to the surgeon, as we read of a shell piercing the battle dressing station, passing near the medical officer, and killing Midshipman Lamb, who had just been treated for a badly fractured arm.

The Naval Regulations, United States Navy, 1814, page 16, stated that the surgeon shall "be ready with his mates and assistants in an engagement, having all things at hand necessary for stopping of blood and dressing of wounds."

The Rules, Regulations, and Instructions for the Naval Service of the United States, 1818, directed the ship's surgeon to distribute tourniquets to different quarters, two or three to each one, so that the wounded may suffer as little loss of blood as possible before their transfer to the cockpit. Instruction by the medical officer in the use of the tourniquet was prescribed.

As an interesting side light on this period, it may be noted that at sick call, which was announced by the lob-lolly boy ringing a bell, the deck of the sick bay was sprinkled with vinegar, the latter procedure having been in use in the British Navy for many years previous to this time.

The next edition of naval regulations, issued in 1821, made no change in medical regulations other than to provide a medical storeroom aboard each ship.

The specified equipment of the cockpits—the fittings of the battle dressing station in those days—consisted of "glass lanthorns, basons, candlesticks, bleeding cups, large table," etc.

In 1852 the surgeon's division on board ships of the United States Navy was described as composed of the medical officers, the chaplain, the purser, the professor of mathematics, and other persons designated by the commanding officer to assist the medical department in action. This paragraph was later amended—presumably because of slight friction having arisen—to the effect that the above-mentioned lay officers "will be *with* the surgeon's division, but not *under* his direction, and will render such assistance as their feelings may dictate."

The medical officers were required to make all necessary preparations for the reception and treatment of wounded in the part of the ship set apart by the commanding officer. They were also directed to see that a sufficient number of tourniquets, "or temporary substitutes for them," were distributed to the different parts of the ships, and that all persons in the surgeon's division and "such others as the captain may direct are instructed in the use of tourniquets, to prevent as far as possible, any dangerous loss of blood before the surgeon or his assistants can attend to wounded men."

The battle station of the surgeon's division was the "cockpit or such other convenient place as the captain of the vessel may direct." To the officer in charge of the division on the orlop or berth deck was delegated the responsibility of seeing that the devices which were provided for lowering the wounded from the various decks "were ready and properly fitted and that the wounded, when lowered down, are conveyed to the part of the vessel set apart for the surgeon's division."

The device specified for the lowering of the wounded was "a cot with a spare sacking-bottom, or other simple apparatus, as the captain may determine upon consultation with the surgeon."

The regulations state that the officers commanding each division of guns will cause the wounded of their division to be "properly conveyed to the surgeon."

The following letter from Surg. J. M. Browne, United States Navy, to the Chief of the Bureau of Medicine and Surgery explains some of the medical arrangements on combatant ships in the American Civil War (15):

UNITED STATES STEAMER "KEARSARGE,"
Deal Roads, England, July 23, 1864.

DEAR SIR: I deem it appropriate to acquaint you with certain details appertaining to the engagement and its results between this vessel and the *Alabama*.

The guns' crews were instructed in the application of tourniquets made for the occasion, and an ample supply furnished each division. Cots for the transportation of the wounded were in convenient positions, yet neither were brought into use. This has explanation from the fact that the wounded refused assistance from their comrades, concealing the severity of injury, and one (Gowin, ordinary seaman) dragged himself from the after pivot gun to the fore hatch, unwilling to take anyone from his station. While I should ever make similar preparations on the eve of contest, the example of the one in question would teach me that, under the excitement of battle, little reliance could be placed upon the fulfillment of my instructions. This vessel is exceedingly deficient in provision of conveniences for wounded men; there is no appropriate place for the performance of operations.

Acting upon my recommendation, Lieutenant Commander Thornton, executive officer, caused the fore hold to be arranged for the accommodation of six wounded, after the application of temporary dressings, that they might have immunity from the exposure subjected to while upon the berth deck.

The action continued for eighteen minutes without casualties. Then a 68-pound Blakeley shell passed through the starboard bulwarks below main rigging, exploding upon the quarter-deck, and wounded three of the crew of the pivot gun. * * *

In 1866 additional provision was made for the assignment of one hatchway, or portion of a hatchway, as nearly amidships as possible, for exclusive use in lowering the wounded. This hatchway was to be specially provided with cots having a whip attached to each.

As of passing interest it may be stated that the battle preparations of the medical department of the Confederate States Navy were almost identical with those of the United States Navy of that period. "A cot with a spare sacking-bottom" was the prescribed apparatus for lowering the wounded to the orlop or berth deck. The directions for distribution of tourniquets and instructions regarding their use were similar in the two naval services.

The Instructions for Medical Officers, United States Navy, 1886, required that the surgeon of the ship shall have everything in readiness for relief of the wounded and a sufficient number of tourniquets be distributed to men who have received instructions in their use. In the Spanish-American War, vessels of the United States Navy, as a general rule, established two dressing stations. The 1906 edition of Instructions for Medical Officers—the first revision in 20 years—was much more elaborate in its discussion of medical preparation for battle, afloat or ashore, a fact attributable to the interest in this phase of medical activities being stimulated by the battles of the Russo-Japanese War. In his edition, relief stations were specified

which were to be manned by at least four men—members of the crew who had been specially instructed in first-aid procedures. The junior medical officer was required to visit the relief station during action; two battle dressing stations were prescribed.

In 1908, Capt. E. S. Bogert, Medical Corps, United States Navy, successfully advocated that battle dressing stations should be planned and incorporated in all future armored vessels at the time of their design and construction. It was due largely to his efforts that this policy was adopted, although, some 5 years previously similar recommendations had been made.

The instructions for the medical department in action as contained in the Manual of the Medical Department, United States Navy, 1917 and 1922—based upon the lessons of the World War—are comprehensive and explicit, and require no discussion at this time.

It is interesting to note that instructions governing the preparation of the medical department for action at sea are conspicuous by their absence from Hospital Corps Handbook, United States Navy, 1923, although certain other forms of war-time activities are considered in detail.

The recent American literature on the subject of medical preparation for battles at sea is rather sparse, and a similar condition was noticeable a few years after the Spanish-American War. It seems to be human nature to enjoy a lull after each conflict in making preparations for the next national emergency.

It was perhaps the national inclination toward a respite from war preparations, following the Revolutionary War, which prompted our first President to utter his well-known words of axiomatic admonition relative to the proper time to prepare for war.

Outline of Medical Organization

The basic principles which govern the treatment of the wounded of the land forces also control the methods of handling the naval wounded; hence it follows that the tactical disposition of medical units in sea warfare is comparable to the medical stations established by the Army, and the lines of surgical assistance rendered by each are analogous.

The turrets, gun compartments, fighting tops, and other places exposed to the enemy fire have been likened to the "firing line" of land battles. The improvement in submarine warfare, the rapid advance of aviation as a naval weapon, and the increased penetrability of the upper decks from high-angle fire render almost every part of the modern naval vessels analogous to the "firing line."

For the purpose of aiding in outlining the functions of the action stations of the medical department in sea battles, the analogy

existing between the medical organization of land and sea forces is given below, and the similarity of their functioning during and after combat will be followed in this discussion.

The scope of the relief given the wounded at the combat stations of the medical department in stabilized land warfare is more or less fixed, whereas the arrangements of the medical organization for battles at sea must be more elastic and flexible, depending as they do upon duration of contact with the enemy, proximity of shore hospitals, presence of hospital ships, facilities for transfer of wounded from combatant ships, weather conditions affecting the transfer of wounded, etc.

The accompanying chart of medical activities (Fig. 1) is intended to be diagrammatic; several variations are not only possible but probable. In case hospital ships are available, evacuation, immediately after action, of patients from fighting vessels is probable, and it is doubtful if post-combat hospitals will function on board except to care for a comparatively few cases, i. e., nonevacuable wounded. Should the scene of action be located in proximity to home ports, the combatant ships may evacuate direct to shore hospitals, or by medium of medical transports—Class "B" hospital ships.

The corresponding medical activities of land forces and sea forces—arranged in front to rear distribution of echelons of aid to the wounded—are indicated below:

	Land warfare	Sea warfare
	Firing line	Fighting portions of ship—local-aid posts.
	Company aid posts	Temporary battle dressing stations.
	Battalion dressing stations	Battle dressing stations during battle.
Medical regiments	Collecting battalions:	
	(a) Litter-bearer platoons	Ambulance parties.
	(b) Collecting station sections	Principal battle dressing stations—after battle.
	Ambulance battalions (divisional)	Ambulance parties.
	Hospital battalions:	
	(a) Hospital stations ("triage" or sorting) (b) Surgical hospital (for nonevacuable cases)	Post-combat hospitals (sick bays) and operating rooms.
	Ambulance battalions (corps and Army)	Small ambulance boats.
	Evacuation hospitals	Hospital ships if available, otherwise sick bay or advanced base hospitals.
	Hospital centers General hospitals	Shore hospitals—"base," "naval," or "station."

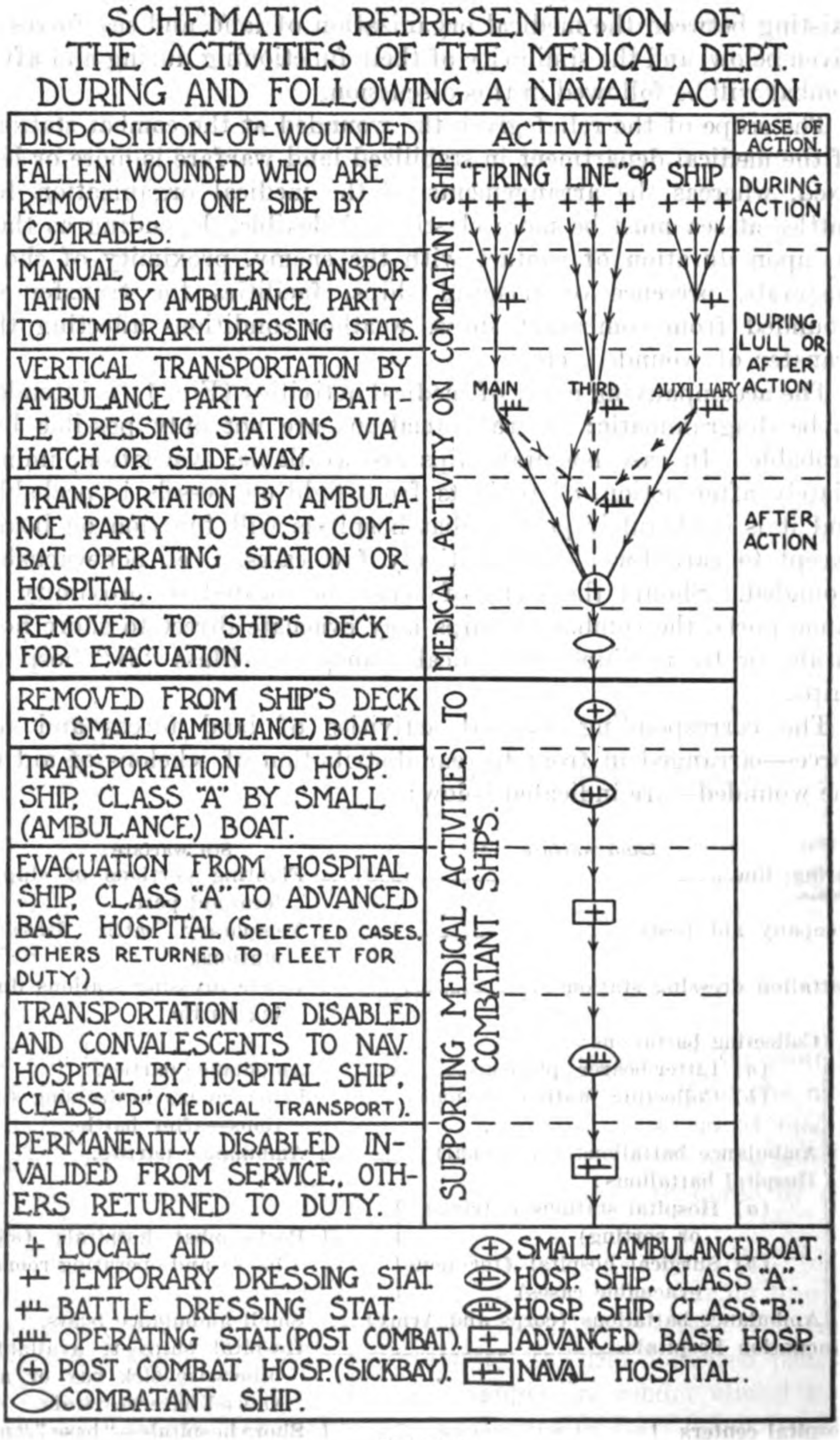
SCHEMATIC REPRESENTATION OF THE ACTIVITIES OF THE MEDICAL DEPT. DURING AND FOLLOWING A NAVAL ACTION
DISPOSITION-OF-WOUNDED
ACTIVITY
PHASE OF ACTION.
FALLEN WOUNDED WHO ARE REMOVED TO ONE SIDE BY COMRADES.
MANUAL OR LITTER TRANSPORTATION BY AMBULANCE PARTY TO TEMPORARY DRESSING STATS.
VERTICAL TRANSPORTATION BY AMBULANCE PARTY TO BATTLE DRESSING STATIONS VIA HATCH OR SLIDE-WAY.
TRANSPORTATION BY AMBULANCE PARTY TO POST COMBAT OPERATING STATION OR HOSPITAL.
REMOVED TO SHIP'S DECK FOR EVACUATION.
REMOVED FROM SHIP'S DECK TO SMALL (AMBULANCE) BOAT.
TRANSPORTATION TO HOSP. SHIP, CLASS "A" BY SMALL (AMBULANCE) BOAT.
EVACUATION FROM HOSPITAL SHIP, CLASS "A" TO ADVANCED BASE HOSPITAL (SELECTED CASES, OTHERS RETURNED TO FLEET FOR DUTY)
TRANSPORTATION OF DISABLED AND CONVALESCENTS TO NAV. HOSPITAL BY HOSPITAL SHIP, CLASS "B" (MEDICAL TRANSPORT).
PERMANENTLY DISABLED INVALIDED FROM SERVICE, OTHERS RETURNED TO DUTY.
MEDICAL ACTIVITY ON COMBATANT SHIP
SUPPORTING MEDICAL ACTIVITIES TO COMBATANT SHIPS.
"FIRING LINE" OF SHIP
MAIN
THIRD
AUXILLIARY
DURING ACTION
DURING LULL OR AFTER ACTION
AFTER ACTION
+ LOCAL AID
TEMPORARY DRESSING STAT.
BATTLE DRESSING STAT.
OPERATING STAT. (POST COMBAT).
POST COMBAT HOSP. (SICKBAY).
COMBATANT SHIP.
SMALL (AMBULANCE) BOAT.
HOSP. SHIP, CLASS "A".
HOSP. SHIP, CLASS "B".
ADVANCED BASE HOSP.
NAVAL HOSPITAL.

FIGURE 1

First Aid to Wounded

It is axiomatic of naval warfare that first aid must be administered to the wounded by the ship's company. Two principal reasons explain this state of affairs, (*a*) the principle of security for the medical personnel during an engagement prevents members of the medical department from exposing themselves for the purpose of administering first aid at the scene of the disaster, and (*b*) there is an insufficient number of hospital corpsmen to provide for a skilled attendant in each isolated compartment.

For members of the crew to be capable of properly applying first-aid measures, a course of training and instruction must be given, and a few remarks on this subject would not be out of place.

First-aid instruction of the crew was adopted in the British Navy in 1855. One of the surgeons in the American Civil War reports that the crew were instructed in first aid, but as a general rule the result of the instruction, as judged from the lay treatment of the wounded in battle, was rather discouraging. The Russian Navy adopted first-aid instruction of the crew in 1898. The senior medical officer of the German ship *Seydlitz* remarked, after the battle of Jutland, that for successful application of first-aid measures by the crew repeated instructions and practical exercise—patiently persevered in—are required.

The intervals between first-aid instruction are apt to be "long, while memories are short," so that little reliance can be placed on the crew for assistance in first aid during battle (16).

"Little benefit is derived from instructing the ship's company as a whole, as although the men will tend their fallen shipmates with a brotherly affection, they shrink from dressing their wounds, and always seek aid from the trained staff" (17).

The majority of the crew "are terrified—and not without reason—at the sight of their mutilated shipmates; instinctively they shrink from touching blood." (Stephens.)

Since hospital corpsmen are not available immediately to apply first aid and the ship's company as a whole can not be depended upon to administer aid to the wounded, then it appears that the best course to follow in a dilemma of this sort is to train selected men from each turret, fireroom, gun compartment, etc., in frst-aid procedure—in addition to giving the crew instructions in the fundamentals of the subject. Certain members of the fire and rescue parties should be specially trained and equipped for first-aid treatment and handling of wounded.

Pryor (18) advocates the "case system." of first-aid teaching, where a small number of men are temporarily assigned to duty in

the sick bay, in order thoroughly to learn by doing the actual work under supervision of the medical department.

Stephens advocates that about 20 per cent of the crew specialize in first-aid measures, so as to become accustomed to the sight of blood and "case hardened" in the presence of pain and suffering.

Immobility of the Medical Department in Action

One of the great advances in the development of medical tactics in the field was the establishment of the principle by Larrey of taking the first-aid treatment to the patient instead of removal of the patient to fixed hospital centers for treatment. Lettermann, during the American Civil War, further developed the idea of mobility of the medical department by organizing hospital facilities transportable to the scene of battle. This principle of mobility of medical formations in the field probably prompted Wise to advocate the mobility on shipboard of a portion of the medical department consisting of junior medical officers and hospital corpsmen who were available for "great catastrophes or single cases of unusual emergency in any quarters."

This medical officer, some 25 years ago, expressed himself rather forcibly in reference to the members of the medical department failing to assume their due proportion of risk in battle, alleging that the conditions of modern warfare did not require the "seclusion or inactivity of the medical department immured in a place of safety."

The state of opinion existing about 18 years ago regarding the mobility of the medical department in action is summed up by Rixey (19) as follows:

"Experience in the Chinese-Japanese, Spanish-American, and Russo-Japanese wars may be taken as conclusively demonstrating the probability of periods of such enforced inactivity on the part of the surgeon's division. Indeed, this is frequently stated as a principle, but it is deemed inadvisable to make a hard and fast regulation of this sort, as it would be most detrimental to the moral fighting trim of the men on the one hand, and, on the other, would interfere with that desirable free play of discretion which must be confided to the surgeon.

"In further reference to the disposal of the wounded, however, it can be stated as a principle that they should not be allowed to lie around, with due considerations for all the requirements of the hour, if this undesirable state can be avoided. They should be cleared away for three reasons: First, humane; second, military, so that they shall not encumber the vicinity of the guns or other space being

employed for offensive purposes, and actually hamper the work of the combatants; third, moral, so that depressing influences which they might exert by their presence may be prevented. These three considerations apply with increasing force to the seriously wounded, the hopelessly wounded, and the dead."

Bell (20), writing some seven years later regarding the question of activity or inactivity of the medical department in an attempt to remove the wounded during action, states:

"The revolution in construction has largely decided the question, effectually tying the hands of the medical department during battle, and, while realizing that fact, there should be encouragement in the thought that not only are the wounded quite as comfortable and protected from further injury where they have fallen as would be the case at a dressing station, but they are also safe from the dangers and torments incident to abandonment and neglect for hours and even days as in the case of the wounded on a battlefield. The wounded on board ship are 'in reasonably clean surroundings and in a tolerable temperature,' and the hour when all can be gathered in and given the attention their varied injuries demand will, in all probability, not be long postponed."

Undoubtedly mobility of the medical service fulfilled one of the principles of medical tactics for land forces, but, in a naval battle, the limited number of medical personnel on board, with no reserves available to handle the large number of expected casualties, renders the exposure of the medical staff to the risk of battle unjustifiable.

At the present time, authorities appear to agree to the principle of immobilization of the medical personnel in a position of security during battle in order to conserve the medical force in its entirety to meet the great demands that come after action. The British regulations (21) are explicit and definite on the subject and specify that all medical officers shall be "stationed under the best possible protection" during action.

"With the development of naval vessels there coincidently developed a fundamentally wrong idea, that the surgeon and his assistants should be about the decks during action, locating and dressing the wounded." (Farenholt.)

"The principle may also be accepted as well established that any considerable mobility of the medical personnel desiring action is impossible as well as inadvisable; that is, a mobility of sufficient degree to reach the wounded in the situation previously mentioned." (Pleadwell.)

One may reasonably expect that at least some officers in charge of fighting parts of the ship, when suddenly surrounded by large numbers of shrieking wounded and burnt cases, will naturally endeavor

to draw the medical officers from their places of seclusion to assume charge of the situation. A circumstance similar to this actually happened in the North Sea action of January 24, 1915 (22).

While our official instructions of 1922 state that the ambulance parties must be warned not to go on decks or into turrets during action, it would appear advisable to promulgate official instruction specifically prohibiting the medical staffs from being withdrawn in time of action from a sheltered position for the purpose of handling the wounded at the scene of disaster, and thus indoctrinate the naval service with the principle of immobility of the medical department during action.

Medical tactics on combatant ships differ from medical tactics of "attached" medical troops by adopting the principle of relative immobility and security during battle. The primary reasons for this difference—as noted above—are that combatant ships carry no medical reserves, and the line of communication with supporting hospitals is not continuous, whereas the units of land forces usually maintain an open line of communication with available medical replacements or other medical units in support or reserve.

OUTLINE OF TREATMENT

Action station	Dressing	Shock	Hemorrhage	Disposition of wounded
Local aid	Apply occlusive dressing.	Water from canteen; recumbent position; words of encouragement to allay fear; smoking permitted; avoid cold and exposure. (Morphine)	Bandage or tourniquet compression.	Slightly wounded remain at post. Severely wounded are removed out of way of fighting force during action; transfer to dressing stations at first opportunity.
Battle dressing stations (during action).	Clean and re-dress, if time permits; emergency surgery to save life.	External heat, hot-water bottles or canteens filled with hot water. Morphine. Hot drinks. "Dressed litters."	Plugging, compression, or forcipressure.	Remove to space arranged for reception of the wounded.
Battle dressing station (after action).	Thoroughly cleanse wound, remove foreign particles, under anesthetics if necessary; careful examination of patient; apply splints.	Morphine, warmth; warm tea, coffee, soup; pituitary extract. "Dressed litters."	Ligation if necessary, hypodermoclysis.	Remove to post-combat hospital.
Post-combat hospital.	Re-dress when necessary.	Continue warmth; treat secondary shock.	Glucose and sodium chloride solution if Hb. is over 25 per cent; if below this figure transfuse whole blood.	Evacuate from ship as soon as practicable.

Lieut. Commander D. C. Walton, Medical Corps, United States Navy, has prepared the subjoined tables showing the basic principles of gas treatment at the various medical action stations. This authority states that the tables are intended as an outline, by no means final, to serve as a guide in the preparation of medical plans.

He believes that in the event of gas warfare it is probable that newer chemicals, used as weapons, will require other therapeutic measures to supplement those listed herein.

Medical battle station	Equipment for gas treatment	Gas treatment
Local aid posts	1 quart 1 per cent $CuSO_4$ in water; 1 quart carbon tetrachloride; 1 pint 5 per cent NaOH in water; 1 pint 2.5 per cent soda bicarbonate in water; 2 head-injury masks; 50 gauze sponges.	Lachrymators, sternutators, lung irritants: No treatment (mask patients). Mustard splashes: Remove liquid with CCl_4. Skin irritant arsenicals: apply NaoH solution. Lachrymator splashes: Apply soda bicarbonate. White phosphorus burns, if smoldering: Apply $CuSO_4$.
Battle dressing station during battle.	3 quarts 1 per cent $CuSO_4$, in water; 2 gallons carbon tetrachloride; 2 quarts 5 per cent NaOH in water; 1 quart 2.5 per cent soda bicarbonate in water; 8 ounces ferric hydroxide glycerin paste; 1 quart alcohol, chloroform, and ether mixture; 600 gauze sponges; 10 head-injury masks; 1 pound chloride of lime; 2 venesection outfits; 2 intravenous outfits.	Lachrymators: Treat eyes and splashes with soda bicarbonate. Sternutators: Inhale A. C. E. mixture. Lung irritants: Warmth, rest, venesection, and intravenous injection. Mustard splashes: Undress outside dressing station, place clothing in tubes of chloride of lime; treat skin with CCl_4 and chloride of lime. Arsenical splashes: Apply NaoH and ferric hydroxide paste. White phosphorus burns: $CuSO_4$ if smoldering.
Battle dressing station after battle.	No change in equipment	Excise arsenical burns when possible. Treat eye burns with soda bicarbonate and silvol. Treat mustard burns with dichloramine T. Continue treatment of lung cases.
Sick bay (postcombat hospital).	Oxygen cylinders and Haldane masks.	Continue treatment of burns. Treat lung-irritant cases and cases of carbon monoxide and nitrous fume poisoning with rest, warmth, and oxygen. Treat vesicant gas inhalation cases symtomatically.
Hospital ships	do	Continue special treatment.
Base and naval hospitals.	Oxygen chamber; graduated exercise apparatus.	Continue treatment of burns and lung lesions. Special treatment for late cardiac, mental, and functional eye disorders.

Estimates of Normal Sick and Injured

Before considering plans for battle casualties, estimates must be made first of the number of "normal sick and injured."

The term "normal sick and injured," as the words imply, is used to designate the routine cases of diseases and injuries which may be expected under average circumstances; the term "normal casualties" is used in contradistinction to the "battle casualties."

Credit to Chief Pharmacists W. H. MacWilliams and Leland Rowe, of the United States Navy, for the compilation of much of the following data is hereby acknowledged.

The average daily percentage of sick and injured on 10 battleships for the 10-year period (1914–1923, inclusive) was found to be 0.8075.

It was impracticable, from the data available for this extended period, to separate the preceding percentage into the "normal sick percentage" and "normal injured percentage." However, the admissions on 10 battleships for the year 1923 have been accepted as indicating the probable relative frequency of injury and disease. According to this source of information, the number of patients admitted with injuries compared to the number admitted with dis-

eases gives a ratio of injury to disease of 1 to 8.7. Hence, in every 10 cases treated on combatant ships 1 will be injury and 9 will be disease, approximately.

Assuming that diseases and injuries have the same number of sick days, the normal sick and injured rate of 0.8075 per cent can be divided into normal injured rate of 0.08075 per cent and normal sick rate of 0.72675 per cent.

Manifestly, some of the normal sick and injured patients are retained on board ship for "definitive" treatment, while others are transferred to hospitals (including hospital ships).

A study of the transfers from 10 battleships in full commission over a period of seven years (1917–1923, inclusive) was made. Such study showed that, for the period considered, the average annual number of patients transferred to hospitals (including hospital ships) was 14.95 per cent of the complements. The median percentage was 14.62.

Using the total readmissions (RA) for naval personnel reported by hospitals and hospital ships, together with the total hospital sick days therein, as a basis, the average sick days per case over a period of seven years (1917–1923, inclusive) was found to be 32.54. The median rate for the same period was 31.25 sick days. All base hospitals are included in the above computation, but not the sick quarters (when same existed) at Quantico, Va., or the field hospitals in Haiti and Santo Domingo. The average number of sick days per case was highest in 1919 and 1920, when the chronic cases of the war were being cared for—amounting to 36.24 and 34.51 sick days, respectively.

The daily rate of transfers to hospitals during the period studied may be obtained by dividing the average annual and median rates of 14.95 and 14.62, respectively, by 365, which gives the following:

Average daily rate of transfers to hospitals, 0.041 per cent of ship's complement.

Median daily rate of transfers to hospitals, 0.040 per cent of ship's complement.

If each case was carried an average of 32.54 sick days and 0.41 per 100 of those on board were transferred to hospitals each day, the daily average per 100 of ship's complement would be 1.334 cases under treatment in hospitals (including hospital ships).

The same data based on the median rates would be 1.25 cases.

Certain assumptions must be made in order properly to utilize the above figures. It is highly probable that some of the battleships were at sea during certain portions of this time—or for other reasons did not have opportunity to evacuate some of the cases that should have been transferred to hospitals. However, it is assumed

that such circumstances did *not* exist and that all cases needing hospital attention were immediately transferred. This assumption allows us to regard the normal sick and injured rate of 0.8075 per cent as being composed entirely of nonhospital cases.

The preceding figures have certain practical value. For instance, if a fleet of 10,000 personnel is at sea for a prolonged period of time under conditions that do not permit evacuation to hospital ships, the sick bays of the fleet—at the end of this period—will contain normal sick and injured, composed of (*a*) cases usually treated on board, and (*b*) cases usually transferred to hospitals. The former will show a daily average of 80.75 patients. The cases that should have been evacuated to a hospital under normal conditions will show an average *increment of 4.1 cases each day*, and when the maximum is reached the number accumulated on board will be 133 cases needing hospitalization. Adding the " retainable " cases of 80 to the " evacuable " cases of 133 gives a total of 213 patients in the sick bays as the daily average for a fleet of 10,000 men, or 2.13 per cent of the fleet's complement on the sick list.

The relation existing between the number of persons admitted to the sick list and the number transferred to hospitals (including hospital ships) has not been ascertained in time to embody in this study. However, it has been determined that for every man transferred to hospitals or hospital ships there were 19 cases under treatment on board ship.

Or, otherwise expressed, a ship averaging 10 men on the sick list may expect to average 1 patient transferred to hospital every second day.

The following data relating to naval service may be of additional value in making our computations.

The average number of sick days for each person of the naval service is 12.3 per annum—based upon the average of the 10-year period of 1914–1923, inclusive.

Approximately 3 per cent of the naval service are constantly on the sick list; and approximately 2 per cent of the naval service are constantly under treatment at naval hospitals (including hospital ships).

Summary

1. Average daily percentage of complements of capital ships carried on sick list, 0.80.
2. Average daily percentage of complements of capital ships transferred to hospital and hospital ships, 0.04.
3. Average daily percentage of complements of capital ships under treatment in hospitals (including hospital ships), 1.33.

4. Ratio of the average daily number transferred to hospitals to the average daily number of patients carried on sick lists of capital ships, 1 to 19.

5. Ratio of injury to disease, 1 to 9.

Estimates of Battle Casualties

It would appear that the ratio of the casualty rate of a superior force to the casualty rate of an inferior force is out of all proportion to the ratio of their fighting powers. Note the practical absence of casualties in United States Navy during the Spanish-American War compared to the severe losses of the opponents. The following examples from the World War demonstrate the disparity in casualties existing between the superior and inferior naval forces.

(*a*) The German losses at the naval engagement off Helgoland on August 28, 1914, in killed, wounded, and prisoners "must have been well over 1,000," whereas the British losses did "not exceed 35 killed and about 40 wounded" (Corbett) (23).

(*b*) The German fleet—the superior in numbers, design, speed, and gun power—at the action off Coronel on November 1, 1914 had none killed and only six wounded, all on the *Gneisenau*. The British lost practically the entire complements of the *Monmouth* and *Good Hope*. The total weight of metal that could be thrown by Admiral Von Spee's fleet was 3,504 pounds, while the British fleet could discharge 2,160 pounds.

(*c*) In the duel on November 9, 1914, between the *Sydney*, with a broadside of 500 pounds, and the *Emden*, with a broadside of 175 pounds, the respective casualties were out of all proportion to their fighting strength. The casualties of the former ship were 4 killed and 12 wounded, while on the latter ship there were 113 killed and 56 wounded (23).

The status of the *Emden's* complement after battle has also been given (24) as 142 wounded, 94 unwounded, 98 missing; 334 total complement.

(*d*) At the naval engagement off Falkland Islands, on December 8, 1914, the British squadron, enjoying the supremacy in a return engagement with Admiral Von Spee's force, suffered no personnel casualties in the main action. During this time the entire crew of the *Scharnhorst* was lost, while on the *Gneisenau*, after some 600 men had been killed and wounded out of a complement of 850, and the ship was unable to fire another shot, the sea-cocks were opened and the vessel sank.

In the subsequent part of this engagement, the British ships *Glasgow* and *Kent* lost one killed and four wounded, and 4 killed and 12 wounded, respectively. Of the two German ships *Leipzig* and *Nurnberg*, there were only 18 and 7 survivors, respectively.

It is true that a proportion of these casualties is attributable to drowning by the sinking of the ship, yet, if these are excluded and only the casualties from shell fire are considered, it will probably be found that a marked disparity between the casualties of a superior and those of an inferior force is still discernible. Unfortunately, records of the personnel losses from gunfire, taken prior to the sinking of a ship, are seldom obtainable. The slaughter and carnage on board a ship gradually being sunk by gunfire must be terrible. A surviving German officer from one of the ships in the last-mentioned engagement reports that nearly every one on the upper decks had been killed by shell fire before the ship sank.

Estimate of Casualty Rate for Total Force

The weapons of naval warfare have undergone vast and remarkable changes, yet the fundamental psychological traits governing the behavior of the naval personnel under war conditions remain almost stationary. The basic physical limitations of the fighting man in his dugout canoe are approximately identical with those of the man behind the guns of the superdreadnought, as indicated by the fact that history shows the degree of damage a fighting force is able to withstand to be remarkably constant.

Under present conditions of modern naval warfare, two fleets of equal strength and determination will probably inflict about 20 per cent of casualties on each other before one or both withdraw. (Pasquale and Susuki, quoted by Farenholt.)

This percentage—as a general rule—will decrease as the size of the fleets increases. For a fleet with a complement of 16,000, Bell regards 20 per cent as a "reasonable expectation of casualties."

The Spanish casualties at the naval engagement off Santiago amounted to 22 per cent of the force employed, and this figure is exclusive of the wounded who escaped through the woods and reached Santiago de Cuba.

The total casualties of the Japanese in their campaign, which included several separate actions against the Russians, amounted to nearly 16 per cent of the total force. It has been estimated that 30 per cent of the Russian force at the battle of Tsushima were lost.

Zur Verth believes Blackwell's estimate that, in an action lasting half an hour, 20–30 per cent of the personnel will be killed and wounded is "too high in large battles." Yet the former authority estimates that 5–10 per cent of the force personnel will need accommodations on hospital ships after action and if the percentages killed and slightly wounded are added to this it will approximate Blackwell's lower estimate of 20 per cent for force casualty rate.

British Losses in Naval Battles (25)

Battle	Total force	Total casualties per cent of force
Camperdown	8,221	10.03
Nile	7,985	11.22
Trafalgar	17,772	9.51
Jutland	60,000	11.14

The table above gives the British losses in naval battles, which losses, in terms of the per cent of the total force, show very little variation in the past century.

In view of an 11 per cent casualty rate for the British forces engaged in the indecisive battle of Jutland, it would appear that an estimate of 20 per cent for the casualty rate of a force engaged in a decisive modern action would be none too high.

Estimates of Maximum Casualty Rate on Individual Ships

While a 20 per cent casualty expectation appears to be reasonable for the personnel of a fleet, yet these casualties will not be equally distributed among the individual ships in proportion to their complement.

It is, therefore, manifestly essential that our medical plans take cognizance of the *maximum* per cent of casualties aboard individual ships and not the *average* per cent of casualties.

A ship suffering 40 per cent of casualties will probably be placed out of action, and any percentage above this figure will create such disastrous conditions and will disorganize the medical department to such an extent that it will practically cease to function. The wounded of the *Emden*—which had a casualty rate of over 40 per cent—received on the *Sidney* about 24 hours after the termination of the battle were found to be infested with maggots ¼ inch long, crawling in the wounds (26), a condition suggesting complete disruption of medical activities on board the defeated vessel. (Fergusson (27), visiting the wreck of the *Emden* later for the purpose of removing the dead, found the sick bay "absolutely untouched," which was rather peculiar in view of the extensive destruction in other parts of the ship.)

On the other hand, we read of the flotilla leader, *Broke*, which reported 41.50 per cent of casualties, including the surgeon killed, limping into port when attacked by two German ships. In spite of this heavy personnel loss she yet had sufficient fighting strength and organization remaining to make a show of resistance and cause the two attacking ships to withdraw.

It would appear safe to assume that 40 per cent is the maximum casualty rate for individual ships. While this maximum is seldom

reached, if the wounded of the enemy cared for on board are included with the other casualties the number of instances where the casualty rate is around 40 per cent will be increased.

It would appear that further development and use of airplanes as a weapon in naval warfare will materially influence the percentage and type of casualties on board ship.

Should gas projectiles or other methods of chemical warfare be employed in naval action, it is highly probable that the maximum casualty rate for individual ships and the force casualty rate will be greatly increased. This is explainable by the fact that chemical warfare is aimed primarily toward the annihilation of personnel, the proportion of material destruction being negligible. Gunnery as a naval weapon is designed, primarily, to wreck matériel, and, secondarily, to destroy personnel, hence the loss of mechanical power from the effects of gunfire is usually proportionally greater than the loss of physical power.

One of the largest percentages of casualties aboard an individual ship which remained afloat occured on the *Lawrence*, where 83 out of 103 persons on board were killed or wounded. The Paraguayan force lost 50 per cent in killed and wounded at the battle of Rïachuelo. The *Chen Yuen* in the Chino-Japanese war suffered 76 per cent casualties.

The following is a list of other ships with high casualty rates.

Casualty rate, per cent of complement

Ardent at Camperdown	30.51
Bellerophon at the Nile	33.73
Majestic at the Nile	33.04
Bellerophon at Trafalgar	26.37
Collosus at Trafalgar	32.41
Gromoboi at Yellow Sea	37.00
Broke at Jutland	41.50

Ratio of Killed to Wounded

Richards (28) has demonstrated a rather interesting principle underlying the ratio of killed to wounded in naval battles: As the percentage of total casualties increases, the ratio of killed to wounded rises rapidly. He cites the following figures of Russian casualties to illustrate this fact:

	Killed and wounded	Killed	Wounded
	Per cent	*Per cent*	*Per cent*
Battle of Aug. 10	8	1.3	6.6
Battle of Aug. 14 (all ships)	36	13	23
Battle of Aug. 14 (Rurik only)	52	22.5	29.5

Farenholt (7) regards the ratio of 1 killed to 4 wounded as fairly constant up to a 20 per cent loss; beyond this it rapidly increases. He explains this by assuming that a certain percentage of men aboard a modern ship occupy positions relatively invulnerable to gunfire. After the first ocurrence of casualties in the vulnerable portion of the ship, each succeeding hit in the vicinity of a former accident tends to kill the severely wounded and increases the severity of the condition of the injured by inflicting additional wounds. From a theoretical view, a continuation of hits will eventually kill all those occupying vulnerable positions, while the men occupying protected positions remain unwounded.

The fact should not be overlooked that a relation exists between an increase in force casualty rate and the number of ships sinking, hence drowning may be one of the factors causing the ratio of killed to wounded to vary with an increase of force casualty rate.

NAVAL FORCE AND ENGAGEMENT AND RATIO OF KILLED TO WOUNDED

Chinese fleet, Battle of Yalu	1 to 2.44
Japanese fleet, Battle of Yalu	1 to 2.26
United States Navy in Spanish-American War. (Including casualties ashore)	1 to 4.37
Spanish fleet off Santiago. (Excluding many slightly wounded who escaped to Santiago de Cuba, or otherwise not reported)	1 to 0.57
Spanish fleet at Manila Bay	1 to 1.27
Japanese fleet at Tsushima	1 to 3.70
Japanese fleet at Yellow Sea	1 to 2.23
Russians at Yellow Sea	1 to 5.16
Japanese fleet at Ulsan	1 to 1.61
Russian fleet at Ulsan	1 to 1.76
British fleet at Jutland	1 to 0.11
German fleet at Jutland	1 to 0.19

The statistics of naval casualties show some variation according to sources of information. The data for computing the above ratio of killed to wounded for the Russian fleet at the battle of the Yellow Sea were obtained from the official history of the Russo-Japanese War (29). The ratio given by Farenholt for this was 1 to 4.61.

Taking the figures of the British casualties at Jutland as given by Corbett, the ratio of killed to wounded is 1 to 0.08. The discrepancy existing between this ratio and the one presented in the table is apparently due to the fact that those dying of wounds were classed in the former figures as killed, and in the latter as wounded.

In the interpretation of the ratio of killed to wounded, there are two factors to be considered:

(*a*) The number of wounded who are drowned by the subsequent sinking of their ship should be ascertained. This is usually impossible on account of the ship's sinking before the records of the number of wounded have been prepared, or else the loss of this data. Hence many of the wounded who are later drowned are classed among the killed, which tends to equalize the ratio.

(*b*) The number of deaths from drowning is a factor—manifestly not present in land warfare—which disturbs the estimated ratio of killed to wounded in recent naval battles. Excluding the deaths from drowning at Jutland, the British ratio of killed (461) to wounded (663) was 1 killed to 1.43 wounded.

After a study of the ratios of killed to wounded, cited above, it would appear fair to assume—on account of the large number of deaths from drowning and the high mortality rates in modern turret accidents—in a future naval engagement of a major character that the number killed outright (including drowned) will approximate the number wounded, the estimated ratio of killed to wounded being then 1 to 1.

This ratio is in accord with the casualties of the Japanese Navy in the Russo-Japanese War, where 1,887 were killed outright and 1,787 were wounded.

As a matter of passing interest in this connection the following information is presented. The German naval losses in the World War were 26,685 killed, of whom 10,625 were marines. According to a report of the British Admiralty, issued on November 26, 1918, the naval casualties of that nation had been 29,766, of whom 23,361 were killed or died of wounds, and the remainder (6,405) are classed as wounded, missing, or prisoners.

Estimate of Percentage of Force Wounded and of Maximum Percentage of Ship's Complement Wounded

The force-casualty percentage and the maximum casualty percentage for individual ships have been discussed in detail, but these should not form the bases for the computation of the medical, surgical, and hospital requirements for the fleet or for individual ships. The wounded percentage and not the casualty percentage should be given primary consideration in developing medical plans for action.

The force-wounded rate in modern action is apt to be relatively smaller than formerly, which is demonstrated by a study of the British casualties at Jutland. In this engagement the British lost 6,014 killed outright, while the total wounded amounted to only 674 (of whom 74 later died of wounds). The wounded percentage of the force engaged was 1.12; the fatality percentage of the force engaged was 10.02. The disparity of force-wounded rate to force-fatality rate (1.12 to 10.02) is largely due to the number of deaths from drowning; 3,301 fatalities alone were caused by the sinking of three battle cruisers.

Richards (28) says: "It has been generally believed that about 20 per cent is an average casualty list to be anticipated from gunfire in naval battles and that only 4 per cent will be killed outright, though

I think this will prove far too low an estimate for any force which suffers defeat."

A mean minimum percentage of 20 per cent losses for the whole force must be assumed, and we may expect 4 per cent killed in battle, 8 per cent seriously wounded, and 8 per cent slightly wounded (7).

These figures would give a force-wounded rate of 16 per cent.

In view of the above statements and notwithstanding the low force-wounded rate for the British at the indecisive Battle of Jutland, it would seem fair to assume a force-wounded rate of 10 per cent. To lend support to this assumption it may be mentioned that of 2,300 persons composing the crews of the Spanish fleet at Santiago, 200 were wounded, giving a force-wounded rate of 8.70 per cent. The force-casualty rate was previously assumed to be 20 per cent, hence killed and wounded are assumed to be equal in number.

The maximum wounded rate for individual ships should also be differentiated from the maximum casualty rate of individual ships, and as a general rule the two rates will vary inversely as the size of the ship, as is shown by comparing the rates of the larger and smaller of the surviving British ships suffering the most—in their respective classes—at Jutland.

	Total casualty rate	Wounded rate	Remarks
Capital ships:			
Lion	11.87	4.15	5 died of wounds.
Malaya	9.78	6.58	32 died of wounds.
Princess Royal	8.31	6.73	3 died of wounds.
Lighter vessels:			
Broke	41.50	18.00	None died of wounds.
Chester	18.39	11.55	6 died of wounds.
Southampton	17.87	12.04	5 died of wounds.

Shall these low wounded rates on capital ships be accepted as a basis for estimating our medical requirements? Compare the above table with the one below, prepared from data given by Beyer.

	Total casualty rate	Wounded rate
Mikasa	16	15
Rossija	20.7	15
Gromoboi	37	27.9

The discrepancy existing in the ratios of the total casualty rates to wounded rates in the two preceding tables may be partially explained by the fact that the large powder fires which occurred on British capital ships caused casualties with a larger proportion of deaths than is usually caused by the direct action of gunfire. Bogert

is authority for the statement that a Japanese surgeon has estimated the probability of casualties to every large shell bursting on board, to be 30 per cent severely wounded, 60 per cent slightly wounded, and only 10 per cent killed outright. On the other hand, the casualties from powder fires often included 60 to 90 per cent fatalities, and in some of the turret accidents the fatalities composed nearly 100 per cent of the casualties occurring in that location.

In view of the high-wounded rate in the latter table, it is wise—considering possibilities as well as probabilities—to adopt higher wounded rates than those given for the British at Jutland.

We may therefore assume a maximum expected wounded rate of 20 per cent for light vessels, using the wounded rate of the *Broke* as an approximation for the assumption.

The average of the wounded rates for the three British capital ships and the three ships of the Russo-Japanese War—listed in the above tables—is 12.5 per cent. Allowing a margin of safety, we may assume that the *maximum number wounded on individual capital ships will be 15 per cent of the ship's complement.*

It is the maximum wounded rate for individual ships that determines the medical and surgical war-time requirements for this type of vessel, while the force-wounded rate serves as a basis for computing the evacuation facilities, and this figure will be used later in determining the bed accommodations to be furnished by hospital ships and shore hospitals.

A wide discrepancy will be observed in the assumed ratio of killed to wounded in the total force casualties (1 to 1) and the actual ratio observed for the casualties of surviving ships showing the largest casualty rates (1 to 15 for the *Mikasa*). This discrepancy is attributed to the fact that the fatalities from drowning caused by sinking of ships raises the ratio of killed to wounded in the former but does not influence the ratio in the latter.

It would simplify matters to classify naval casualties under three captions, viz, (1) killed, (2) wounded, and (3) drowned, and then omit the deaths from drowning in further considering casualty estimates, as this form of casualty is, as a general rule, of little concern to the medical department in making plans for battle.

Causes of Deaths

In modern naval engagements more deaths are usually due to drowning than to all the other causes combined. This was not quite true in the days of wooden ships, which were able to withstand a comparatively large amount of punishment from gunfire before sinking.

In the Battle of Lissa, fought in the transitional period of the change from wood to steel ships, the Italians lost 615 men from drowning by the sinking of steel ships, while only five were killed by gunfire.

The Spanish vessels in the two major naval engagements of the Spanish-American War were usually within a short distance of the shore, and were in shoal water when they foundered, which conditions undoubtedly account for the comparatively small number of deaths from drowning.

In the Battle of Jutland the British lost 5,553 officers and men from drowning, some of which were probably wounded or killed before the sinking of the ship.

Next to drowning, shell wounds assume the most important place as a cause of deaths in naval action. In the Battle of Jutland it has been estimated that the British losses due primarily to shell wounds were 370. In 160 cases burns seemed responsible, while in 4 cases there was no trace of injury.

Capital ships show a wide variation in the percentage of deaths due to shell wounds and the percentage due to burns. On three of the British capital ships, all deaths—22, 19, and 20, respectively, were due to shell wounds; on the *Malaya* all deaths (65 in number, including 32 dying later) were attributed to burns, while the *Lion* lost 48 killed by combined shell wounds and burns, 49 by shell wounds only, and 2 by burns only (25).

Japanese losses in their campaign against the Russians amounted to—

	Per cent of total force
Killed during battle	1.89
Drowned	6.14
Wounded	7.62
Total casualties	15.66

At Jutland, the British lost three men from gas poisoning, two deaths apparently being caused by nitrous fumes, and one by a mixture of gases including carbon monoxide.

There were no deaths from scalds in this battle. On the older-type ships unprotected steam pipes seem to have run in all directions, as steam connections were used in many locations where electricity is now utilized. Escaping steam in closed or semiclosed compartments caused a large number of deaths on board the Spanish vessels off Santiago. On two of these ships the entire personnel in the engine rooms was killed by escaping steam (13). This prompted one of the Spanish officers to remark that the sad experience should not be forgotten, as battles are fought with men, not automata.

CAUSES OF INSTANT DEATH (JAPANESE CASUALTIES IN RUSSO-JAPANESE WAR)[1]

Location of injury:	
Injuries extending over the whole body	72
Injuries of the head	62
Injuries of the face	10
Injuries of the head and face	14
Injuries of the neck	6
Injuries of the chest	37
Injuries of the abdomen	22
Injuries both of the chest and abdomen	21
Injuries of the extremities	9
Total	253
Location undetermined:	
Wounded and drowned	1,267
Wounded and killed	1
Drowned	361
Suffocated	1
Total	1,630
Grand total	1,883

PROCEDURE

When *war is imminent* the senior medical officer must initiate the necessary measures to insure an efficient state of readiness of his department for action. Special instructions should be given in first aid and methods of handling the wounded. Requisitions should be forwarded for war-time medical and surgical supplies and any vacancies existing in the medical complement should be filled.

If *action is anticipated* the crew must be inspected and all those found incapacitated for duty in battle should be transferred prior to leaving port. The supplies necessary for the care of the wounded should be drawn from other departments.

Shell-wound dressings should be made up; stock solution of antiseptics should be prepared; litters and stretchers should be overhauled; and the heating, lighting, ventilation, and water supply of dressing stations must be inspected and tested. If time permits, clothing of the crew may be sterilized, wrapped in the handkerchief, and stowed in the individual's clothing bag (Colborne) (30).

When *battle is imminent* the dressing stations should be rigged. One medical officer reported that it required about two hours to equip the medical stations, and in one action they had only one-half hour's notice before the engagement started. The result was that much of the equipment was left in the sick bay and destroyed in action.

[1] "Surgical and Medical History of the Naval War Between Japan and Russia, 1904–05."

Bed patients must be removed to a sheltered position; health records and important documents should be stowed behind armor; inflammables should be boxed and kept ready to be thrown overboard. Reference should be made to the Manual of the Medical Department, United States Navy, 1922, for specific instructions in preparing the medical department for the three prescribed conditions of readiness.

General quarters on board ship, lasting as it does for only a few hours, can not convey an adequate impression of the difficulties of the medical department when forced to maintain this condition for a prolonged period.

Bean (31), writing from his experiences on board a battleship which has been "prepared for action" for over four months, recommends, in order to test thoroughly our medical preparedness and to accustom the medical staff to dealing with the sick under war conditions, that "all preparation for war remain existent for at least a fortnight." He says: "Ships may be cleared for action at dawn for days on end. The armored doors will be closed, and only opened, as occasion permits, to allow men to go to their messes for meals. All treatment of the sick must then be carried out at the action stations, the sick bay and dispensary not being available. It is therefore highly necessary that the action station or stations should be permanently fitted as a sick bay and dispensary. If the sick bay and dispensary are used at all, they should be considered as accessories."

Alleviation of pain is one of the methods of lessening or preventing shock, and morphine is an invaluable remedy for this purpose. Chloroform or ether, as has been suggested, may be administered while morphine is taking effect.

Muir tried the use of tabloids of morphine under the tongue and reports that this method was unsatisfactory. He preferred a solution of morphine made up so that a syringeful is equal to ½ grain, this method obviating the necessity of measuring the amount injected, and thus saving time.

Marsh (32) suggests that a glass-barrel syringe is preferable for the administration of morphine during action, as one can judge readily the dose and is able to see the quantity of solution left in the syringe.

McCutcheon (33) supplied morphine to block ships, to be administered by lay officers. He kept morphine in solution in rubber-capped bottles, which proved a very satisfactory method. One needle served for 80 to 90 injections.

Because of the structural peculiarities of the ship and damages by gunfire to paths of communication, it is often impossible for many of the wounded to reach the stations during action; hence treatment

of the wounded during action must generally be limited to first-aid procedures and to the imperative surgery necessary to save life. The following descriptions of a battle dressing station during action portrays what may be expected in modern naval warfare.

"It is essential that everything possible should be done to maintain the morale of the staff. In one action when we waited two hours before any work came along, it was found that their nerves became none of the steadiest. They should be kept going—not too obviously—doing something, no matter how trivial and unnecessary it may seem. It must be remembered that the noise in action is deafening, the concussion and vibration so severe that one feels as if every half minute one were taken by the shoulders and violently shaken; the smell of cordite is sickening in its intensity and penetration, the rumors that are passed along the deck occasionally most alarming, and the stampede of the fire parties to put out even the smallest fire liable to make anyone's heart beat more quickly. Add to all this the absolute ignorance of what is going on up above and the knowledge of the supreme hopelessness of any effort at escape should the ship go down suddenly, and it is not in the nature of mankind to sit calmly waiting for the gruesome sights which we know must come. The only remedy is work and plenty of it. If there is nothing else to be done the staff can always be ordered to swab out the station with izal. The officers must keep a tight hold of themselves, as even an innocent jest has been received with alarm. Once the real work does come along, the medical officer will find that, as if by magic, all traces of excitement disappear and he will be surrounded by an eager, capable band of cheerful workers" (Muir) (16).

"Speaking generally, there is little that can be done during action; in any case the incessant noise alone tends to limit the surgeon's activity. During this period, cooped in his distributing station, he waits in patience under circumstances which test his moral and physical courage to the full. Forbidden the excitement and interest inseparable from watching the effect of the enemy fire, and denied the active participation in the actual battle, his duty remains to instil confidence into his subordinates below. In no crisis is the need for discipline so stern as this. In the battle cruiser the thunderous blast of each salvo from the heavy guns reverberates throughout the ship; hardly has the crash of the first died away than a second takes its place. The bulkheads themselves shudder, shaking down their dust; the electric bulbs rattle in their sockets, and the very decks quiver under the strain. The severe effect of the concussion is felt especially in those medical distributing stations situated beneath turrets. The whole atmosphere is charged with an uproar impossible to describe. The boom of the salvos,

the persistent scream of the enemy shells passing overhead, the sinister whine of the ricochets, the occasional shower of splinters on the resonant armor, the hurrying footsteps of the fire and repair parties above and the swirl of water create an extraordinary medley of sounds which seem wrapped in the muffled roar from the other ships in the squadron. On a shell hitting the ship a dull thud is felt, followed instantly by a terrific explosion—then a moment of intense silence, during which she reels under the blow, rights herself, and proceeds. Under such circumstances her behavior is almost human. As a lull approaches the rhythmic vibrations of the turbines become more evident and gradually the normal familiar noises reappear. This must, of necessity, be only one instance when all goes well; there have been many occasions in which the engines have been put out of action for the time being, and such a catastrophe imposes an additional strain on those at their posts below the upper deck" (Stephens) (8).

In a lull, or after action, temporary dressing stations should be established on upper decks for the care of the slightly wounded which procedure automatically serves to filter out these from the seriously wounded who need more detailed treatment at the regular battle dressing station.

During a lull in the action, as many of the wounded as possible should be collected by the ambulance party and removed to the nearest temporary battle dressing station. After an action, systematic search and removal of the wounded should be undertaken. In tagging the wounded the tag should be placed in a conspicuous place so that the condition of the patient can be readily ascertained without any examination or disturbance of the patient.

Article 1174 of United States Navy Regulations, 1920, provides that, in battles, the medical officer's first duty will be to render such assistance to the wounded as to permit those who are able to return promptly to their station.

After the battle, an effort should be made to treat the cases in the order of their severity. In attempting to determine the precedence of the wounded, Muir says much valuable time may be lost in a thus well-meant endeavor, as it is difficult to decide upon the relative seriousness of the cases except after a careful examination and observation.

The type of surgical interference on fighting ships will be determined by the availability of other hospital facilities and the local condition on board.

Stokes, from his experience in treating the naval wounded of the Spanish-American War after their removal to hospital ships, believes that the type of surgery permissible aboard fighting ships after

action should be restricted, if hospital ships are available. He states (34) that nearly all the surgery performed on combatant ships off Santiago had to be done over on the hospital ship *Solace*.

Bunton (35) sums up his views:

"However, my experience in a double rôle, that of an operating surgeon in a hospital receiving wounded from ships after an action, and that of a surgeon in charge of a ship sustaining many casualties in the Battle of Jutland, leads me to deprecate strongly the performances in dressing stations of operations which could be deferred with safety till patient had been transferred to the more favorable conditions obtaining in a hospital ship or shore hospital."

It may be possible that definitive treatment of the wounded must be undertaken on combatant ships because of the lack of supporting hospital facilities.

Medical Action Stations

LOCAL AID POST

The term "local aid" may be used to designate the lay assistance rendered the wounded immediately after the accident. Local-aid posts—which should include every vunerable occupied portion of the ship—are the locations where first-aid material is available for self-help or mutual aid.

The supplies and equipment for local aid will necessarily vary in quantity and type according to the number of men in the compartment, the hazard of the position, and the type of casualties anticipated.

The first-aid material supplied to a sheltered position occupied by a few men will be simple in comparison to the requirements of a turret during action. For reasons explained elsewhere, local aid must be administered by the lay members of the crew.

In the turrets, and other large compartments where accidents are likely to occur, selected lay members of the crew specially trained in first-aid procedures should be charged with the specific duty of handling the wounded.

RELIEF STATIONS

From a theoretical standpoint, it would be most desirable to provide relief stations equipped with a suitable supply of first-aid material and manned by trained medical attendants, where skilled first-aid treatment is immediately available for each fallen wounded. Unfortunately the division of the ship into many small compartments would necessitate an excessive number of hospital corpsmen; also the principle of conservation of medical personnel prevents carrying out this idea in detail. Hence, the so-called relief stations—

provided for in the 1906 medical regulations but omitted in the 1922 edition—are essentially distributing points for first-aid material.

Redondo some 20 years ago remarked that the "utility of the 'relief stations' is less than generally believed." It would, therefore, appear advisable to avoid the use of this term, and merely speak of "local aid," which will vary considerably in elaborateness between the different portions of the ship. In case the term "relief station" is used, it should be reserved for stations manned by members of the medical department. If any exception is made in the principle of conservation of the medical department in its entirety during action, a precedent is established and it will be difficult to overcome the pressure for further violation of this fundamental of naval medical tactics.

There are reasons to believe that, especially on large ships, a medical station should be established as a buffer between the firing line and the battle dressing stations. The function of this proposed station would be comparable to the "company aid post" of land warfare, which is composed of one medical attendant.

It is therefore suggested that temporary dressing stations be established, during a lull or immediately after action, on the upper decks, two on each deck, one forward and one aft, near the hatchways through which vertical transportation of the wounded to the battle dressing stations takes place.

This station may be designated "temporary dressing station" or "collecting point for the wounded," and functions as follows:

1. Prevents the slightly wounded from going below and congesting passageways leading to battle dressing stations. The rapid sorting of the wounded—en route below—is the primary function.
2. Dresses slightly wounded and returns them to their station.
3. Superintends the vertical transportation of the wounded.
4. A reserve supply of first-aid material may be maintained here to replace that at the local aid posts destroyed or depleted in action.

This type of medical station is somewhat similar to the "postes secondiares" of the French Navy, and to the "transport station" of the German Navy. "Temporary dressing stations" were recommended by Colborne (30) in the World War. Carbonel planned "relay stations, situated at points of relative protection where the wounded may be collected and further disposed of."

It will be noted that the proposed "collecting points" function only after firing has ceased, because of the inadvisability of—as well as the difficulty of—collecting the wounded during action. On this subject Carpenter (36) advises against the collection of the wounded during an engagement, unless they can be disposed in a reasonably protected space, and he cites, to support the view, the experience of the *Reina Cristina* at the Battle of Manila Bay, where the exposed

place for collecting casualties was destroyed by the penetration and explosion of a shell, resulting in the killing of the wounded in mass.

Presumably with a view to preventing the congestion of dressing stations proper with slightly wounded, the German regulations of January 27, 1907, divide the main dressing station into the receiving station and the dressing station proper (18). The function of the receiving station was to treat the slightly injured and sort the other wounded into (*a*) walking, (*b*) transportable, and (*c*) nontransportable patients. Later instructions of the German Navy required the severely wounded after the battle to be taken to the main dressing station, while the auxiliary station was reserved for the slightly wounded.

BATTLE DRESSING STATIONS

The battle dressing station corresponds to the "poste principale" of the French Navy and the "distributing station" of the British Navy. The following are some of the basic requirements for battle dressing stations:

(*a*) Number: Two or more.

(*b*) Easily accessible—one forward and one aft, near hatchways and "normal drift of the wounded."

(*c*) Lighting: Electric lights on two circuits; estimate 200 candlepower for each 36 square feet of area, and hand flashlights and candles. Oil lamps are reported of little value, as concussion of guns and exploding shells blows out their light and is liable to spill the oil.

(*d*) Ventilation: Plenum and exhaust system; fans controllable by switches in order that plenum system can be stopped when poisonous gases are detected.

(*e*) Maximum protection from gunfire.

(*f*) Water supply: One gallon for each casualty estimated; waste-water connections; gravity tank and water stored in other receptacles.

(*g*) The total space available for reception of wounded should be sufficient to accommodate 8 per cent of complement, allowing 6 square feet per patient. Prepare special place for the dead.

(*h*) A temperature of about 22° C. (71.6° F.) is desirable.

(*i*) Situated where there is no interference with the movements of the fighting forces.

(*j*) Adequate storage facilities for medical supplies.

The medical and surgical supplies and equipment for the various action stations vary considerably with the type of ship. It is believed that the details of the matériel requirements are a local problem to be decided by the individual medical officer, based upon his estimate of the number and probable type of casualties. Medical supplies and equipment for action will be discussed later.

The principal dressing station is the one which is larger and more completely equipped and may serve as the operating theater for surgical procedure immediately after action.

The auxiliary battle dressing station should be completely equipped in order that it may carry on the function of one or both of the others in case of their destruction by shell fire. On smaller ships this station can be appropriately designated the reserve battle dressing station.

While the establishment of two dressing stations has the disadvantage of dividing the activities of medical personnel, yet this is more than compensated for by prevention of destruction of the medical department in mass.

The third or fire-room dressing station should be established, on larger ships, to handle the wounded of the machinery spaces. On some of the ships the dental officer is assigned to this station. The function of this station is more in the nature of a large relief station as the emergency surgery contemplated here is very limited in its scope. Unobstructed space for the collection of the wounded is more essential than extensive equipment.

The *Vindictive* established a special battle dressing station for burns, equipped with the necessary dressings and medical preparations for care of this type of wound. There were two objects in view in establishing this station—first, to provide immediate relief to those suffering from burns and, second, to prevent the numerous cases of burns from congesting the other stations.

POST COMBAT HOSPITAL

Prompt evacuation of the wounded from combatant ships is a very desirable procedure, both from a military and humanitarian standpoint. As this is not always attainable, plans must be made for "definitive" treatment of the wounded in a hospital on board. The sick bay, if intact, may be used for this purpose, supplemented by the wardroom and captain's cabin.

The 1917 edition of the Manual of the Medical Department, United States Navy, says: "Any effective organization of medical personnel to meet the demands of the wounded in a naval engagement will usually go beyond the facilities of a single ship and will necessitate the adoption of a more comprehensive scheme of assistance external to the ship, but every vessel should be self-sustaining as far as practicable and no effort should be spared to attain this end."

The British official instructions (21) state that in the absence of a hospital ship the most suitable place for disposition of the wounded will be some portion of the upper deck, properly protected from climatic conditions, and so arranged to afford free ventilation. Portions of the upper decks may be screened in with canvas and used as temporary hospital wards.

In calculating the war-time matériel requirements, especially dressings for the post-combat hospital, allowance must be made (*a*) for the care of the wounded for 10 or more days, (*b*) multiplicity of naval wounds, (*c*) the large areas of some of the shell wounds, (*d*) the septic nature of naval wounds requiring frequent changes of dressings, and (*e*) care of the enemy's wounded.

These factors will necessitate providing the capital ships with a huge amount of dressing material, but fortunately, in case of a shortage of gauze and cotton, there are other materials on board ship that can be utilized for this purpose. It has been suggested that cotton waste and oakum can be sterilized and used in dressing wounds; also sheets, table linen, towels, and so forth are available for the purpose (7).

The length of the period the wounded may remain on board ship awaiting evacuation will vary considerably with the circumstances. The majority of the British casualties occurring in the North Sea actions were removed from warships in less than 40 hours after the infliction of the injuries. This unusually short period was due to the proximity of home bases to the scenes of action which permitted early evacuation of the wounded. Dunbar (6) says that unless the United States adopts a purely defensive system of naval strategy in war, it is most likely that our naval engagements will be at a distance from home ports, and may be at a distance from advanced bases. Consequently, unless the wounded are evacuated to hospital ships in open sea, the wounded will remain aboard the fighting ships for some days. Farenholt considers a period of 7 days to be a fair assumption upon which to base our plans for the care of the wounded after action.

The possibility of caring for the wounded of the enemy must be considered in planning hospital accommodations for use after action. The *Kearsarge* was forced to care for the wounded of the *Alabama*. The *Sydney* furnished temporary hospitalization for 70 wounded of the *Emden*, and this number, in addition to a full complement and over 100 wounded, caused a congestion which hindered the medical activities on board. One hundred and twenty Russian prisoners were treated on board the *Kasugo* after battle.

In case of another engagement the wounded must be removed to a sheltered position behind armor, and this possibility must be kept in mind in selecting a location for the postcombat hospital.

If the ship has suffered serious structural damage in action, facilities for the subsequent transshipment of wounded should be maintained in a state of readiness.

On the *Warrior*, shortly after the surgeons had finished the dressings and operations on the wounded, at 4 a. m. orders came to aban-

don the ship, the *Warrior* then being in tow of the *Engadine*. Thirty wounded were transferred at sea under the most difficult circumstances to the latter vessel. Only one mishap occurred, a litter breaking and causing a patient, who had one arm and one leg shot away, to fall into the water. He was rescued by an officer of the *Engadine*. "The heroic character of that rescue between the bumping, plunging ships may be left to the imagination" (37).

POSTCOMBAT SURGICAL OPERATING STATION

The selection of a compartment as a surgical operating theater for use after action will be influenced by several factors, such as type of ship, damages resulting from action, number of wounded, etc. MacLean and McCutcheon found that their plans for care of the wounded after an engagement were upset by the effect of the enemy's gunfire.

Stephens believes that it is apt to be more practical to improvise an emergency operating room near the upper deck than to use one of the dressing stations.

On the *Southampton*, *Warrior*, *Lion*, and probably other ships a bathroom was used as a postcombat surgical operating station. On the *Lion* the vice admiral's and captain's cabins were prepared for accommodation of the wounded and the captain's bathroom was rigged as an operating room.

MEDICAL EQUIPMENT AND SUPPLIES FOR ACTION

"Medical logistics" is a term used to refer to the procurement, transportation, and distribution of medical, surgical, and hospital supplies, equipment, and facilities.

In times of peace it is incumbent upon the medical officer to assume the initiative in making war plans for his department, and, as the details will vary greatly with the type of ship, it is considered highly important that each ship maintain a concise outline of the procedures to be followed when war is declared. This outline, revised and supplemented by each succeeding medical officer, in event of war should be of invaluable assistance to the responsible medical officer in making his war-time preparations. By the use of this method the advantage is gained of combining the ideas of several medical officers, and there is eliminated the risk of important details being overlooked.

The outline of war preparations maintained on board each ship should contain a list of articles to be procured when war is imminent. Among the articles needed in war, in excess of the peace-time allowances, Farenholt gives the following:

"Anesthetics, twice the present allowance.

"Cotton for dressings, six times the present allowance.

"Gauze for dressings, twice the present allowance.

"Ligatures for dressings, twice the present allowance.

"Muslin for bandages, three times the present allowance.

"Adhesive plaster, four times the present allowance.

"Ethyl chloride, four times the present allowance.

"First-aid packets, two for each person on board."

Colborne (30) recommends that detailed lists of items of medical supplies needed in action be prepared as follows:

(1) Additional stores to be procured in war time.

(2) Articles to be drawn from paymaster, carpenter, and boatswain.

(3) Contents of first-aid haversacks.

(4) Articles to be stored during action in the distributing station and other storerooms.

In this connection attention is invited to article 1166, United States Navy Regulations, 1920, which authorizes the procurement of stores and supplies—for care of patients—from other departments on board upon approval of a requisition by the commanding officer.

The following listed articles may be of some value to the medical department during action and are procurable from other departments on board. The major portion of this list was compiled from suggestions contained in articles by Colborne and Farenholt:

Supply department.—Ponchos for use as rubber sheets; memorandum books; linseed, castor, and other oils; alcohol; memorandum book; towels; blankets for shock treatment; vaseline; lanterns; candles; agate ware—pitchers, basins, buckets, etc.; sheet lead; plaster of Paris; "pattern stuff" for splints; flags to cover the dead; pajamas; clothing; scissors; flannel; sheets; and mattresses.

Boatswain.—Sand for fire prevention; rope for lowering litters; canvas for preparing "chutes"; and canvas for screening off a mortuary.

Commissary Officer.—Tea, coffee, and soups, and means for preparing and serving the same; mess tables upon which to place the wounded.

Carpenter.—Wire cloth and sheet tin for splints; wooden battens for splints; saws for cutting splints.

Marine Officer.—Field cots; additional blankets; mosquito nets, when required; canteens.

Granted that all the medical and surgical necessaries for the care and comfort of the wounded have been procured by the medical department, the proper disposition of these articles must be effected in order that they may best serve the purpose for which they are intended. A shell-wound dressing or a tourniquet in the storeroom would be of little use to the fallen wounded. The needed article in the right place at the proper time is the fundamental of logistics.

PERSONAL EQUIPMENT FOR ACTION

The men below decks of German ships going into action had, either attached to their arms or pinned to their jumpers across their chests, white linen bands on which was stamped in black letters the designation of the duty they had been detailed to perform (13).

This method enables one to tell in what part of the ship the casualty originated, and thus facilitates the collection of other casualties and affords information as to which portion of the ship requires "reliefs."

It has been suggested that white uniforms—if climatic conditions permit—are more suitable for use in battle than "blues." Their frequent washing and the fact that they can be more easily sterilized render "whites" less liable to contaminate wounds. As all authorities seem to agree that practically all naval wounds become infected, it naturally makes one skeptical whether striking beneficial results have resulted from the previous sterilization of the garments worn in action. While this precaution may not have reduced the number of infected wounds, it probably has tended to lessen their malignancy.

Members of the medical department, including ambulance party, should wear the distinguishing red cross brassard. A pocket flash light is an essential part of the equipment of medical officers and stretcher squads.

The suspension of bandage shears from the neck by means of gauze bandage prevents the tendency to misplace this article, which should be part of the individual equipment of the medical party. The "individual equipment"—items 1 to 4 of Field Supply Table, Medical Department, United States Navy, 1923, in "crisis expansion"—and hospital corps pouches can be carried by certain members of the ambulance party.

Morphine solution and a satisfactory hypodermic syringe—Stephens and others regard the Wildey's syringe as the most suitable type for use in battle—should be carried by each medical officer and perhaps by certain other members of the medical department. A description of this syringe is given by Bell.

It is needless to remark that gas masks should be a part of the individual equipment; a reserve supply should be maintained for use of patients.

Stephens reports that several medical officers developed edema of the legs—analogous to the initial stage of "trench foot"—from working for hours after action in salt water over their ankles. He advises rubber boots for use of the medical officers under conditions of this sort.

SUPPLIES FOR LOCAL AID POSTS

Medical and surgical supplies for local aid should be simple in character yet sufficient in quantity.

The systems for distributing first-aid material to the first-aid posts may be roughly classified into (*a*) distribution prior to en-

gagement by means of haversacks, or other bags, containing dressing material, tourniquets, etc., and (*b*) maintaining first-aid supplies in stationary containers fixed in each compartment.

Penfold serving on a British battleship at Jutland made use of both methods of supply to local aid posts. The fixed lockers originally intended for cleaning gear and adjacent to each 6-inch gun, were utilized for stowage of medical supplies, and, in addition to these, two large tin boxes measuring 20 by 12 by 10 inches were used. For other isolated positions, 47 haversack containers were provided. Each of these was sealed with wax, and on the outside were painted a red cross and the name of the station for which intended.

Gitting (38) has made use of large tobacco tins, with a replacable water-tight top for the storage of first-aid dressing materials on board ship. He also devised hermatically sealed tins—each containing six field dressings, two shell dressings, two picric acid dressings, one tourniquet and two bandages. These tins were made with a loose bottom so that it could be soldered after the contents were placed therein. The top was constructed with a ring, attached to the tin in such a manner that, by pulling on the ring, the top could be torn away, somewhat in the same matter as opening a sardine tin.

The first-aid container used in the United States Navy is a sheet-steel box 14 inches long, 10 inches wide, and 10¾ inches high. The planning section, as one of its projects, has given some consideration to improving this by using a transparent front, composed of a material similar to the transparent portion of automobile curtains. By means of this front it would be possible to ascertain immediately the condition of the contents by a casual glance, thus obviating the necessity of opening the box for each inspection, which would render necessary frequent sterilization.

In looking over the literature, it was found that MacLeod (39) had previously developed this idea and had described a dust-proof and water-tight container. (Fig. 2.) In case of emergency the window can be broken easily and the contents thus exposed for use.

The distribution of first-aid material to fighting portions of the ship by means of canvas bags is open to many objections, but as a general rule, is more adaptable to small ships where space for fixed containers is limited. Colborne recommends that each of the first-aid bags be labeled with the part of the ship to which it is assigned. He lists the contents of each haversack as follows:

Tourniquet.
First-aid dressings, 5 of each size.
Bandages, assorted sizes, 6.

Pieces of lint for pads, 10.
Pieces of wool, 10.
Slings, 2.
Pieces of lint with boric ointment, 6.
Picric-acid dressing, 4.

For the haversacks assigned to engine room and stokehold, the picric-acid dressings are increased to 10.

In the first-aid bags supplied by the German Navy to guns' crews, a quart of boric acid solution was inserted for use as an eye wash.

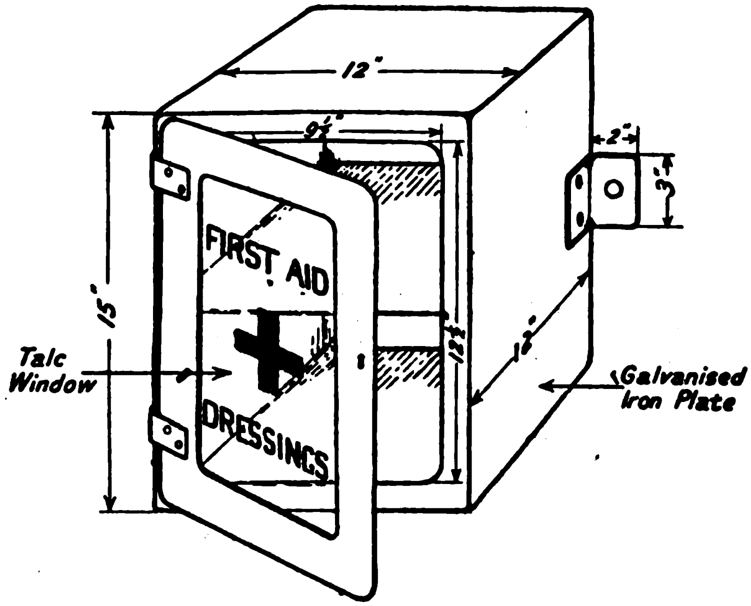

FIG. 2.—First-aid container as a permanent fitting in turrets and casemates, devised by Fleet Surgeon G. E. MacLeod, R. N. (Reproduced, by permission, from Journal of the Royal Naval Medical Service.)

The contents of first-aid bags prepared by Muir were:

Three large packets containing wool, lint, tissues, and bandages.
Two small packets of the same.
One field dressing.
One tourniquet.
Six tablets of morphine and atropine.
Six labels to tag patients given morphine.
Six safety pins.
One triangular bandage.

The shell-wound dressing in use by the German Navy at the outbreak of the recent war consisted of several thicknesses of sublimated gauze, about 6 inches square, sewed to the center of a gauze bandage, 2 yards in length. This was compactly folded and wrapped in oiled paper, and again wrapped in oiled silk and pinned with two safety pins which could be utilized in securing the bandage in place.

The preparation of shell-wound dressings is described in Article 868, Manual of the Medical Department, United States Navy, 1922. It is believed that two sizes of shell-wound dressings are sufficient, and that they should be issued in paraffin paper or cardboard containers, somewhat similar to the dressings supplied in the battle dressing case of the field equipment. Colborne recommends two sizes, viz, 12 inches by 8 inches and 6 inches by 8 inches.

The Medical Department, United States Army, has recently developed two sizes of first-aid dressings, supplied in paraffined, paper-wrapped, cardboard containers. The large dressing is 6 by 11¾ inches and the small dressing is 5 by 7 inches.

In estimating the number of shell-wound dressings required at local aid posts, allowance must be made for the possibility of destruction of some of these in action and for multiplicity of naval wounds.

The small first-aid packet is more suitable for treating the bullet wounds of land warfare than for treating the more extensive shell wounds of naval warfare.

An objection to the present first-aid packet in a metal box is the unusual amount of pull required to open some of the containers. A ring is attached to a metal strip which is soldered to the two halves, and in some instances the solder is unequally distributed, thus increasing the amount of traction required to remove the metal strip. At Marine Barracks, Quantico, Va., some years ago, a series of experiments were conducted to determine the amount of pull necessary to open these packets. It was found that the pull varied from 7½ to 28¾ pounds. It is manifest that a wounded man, suffering from shock, would have difficulty in exerting sufficient muscular effort to open some. A medical officer states that he repeatedly observed wounded men of the American Expeditionary Force with partially opened packets. The Medical Department, United States Army, has improved the method of sealing the two halves, and by eliminating the use of solder a uniform pull of about 7½ pounds (not to exceed 10 pounds) is required to open the container. Sealing is "accomplished by crimping of 26-gauge noncorrosive steel tape over these two beads in such a manner as to press each bead firmly against the gasket between them."

The question of supplying morphine to local aid posts is *sub judice*, but the trend of opinion seems to be inclined to permit the administration of this narcotic by the officers in charge of each turret and gun compartment.

Holmes (40) recommends that an aqueous solution of morphine hydrochloride combined with spirits of ethyl nitrite be supplied to the fighting parts of the ship. The spirits of ethyl nitrite is said to

assist the absorption of morphine, so that the relief from pain is about as rapid as follows a hypodermic injection.

Austen (41) supplied morphine tablets in gelatine capsules, ½ grain as a dose, each capsule being in a box (empty match boxes were used in emergency) and, around each box, four lengths of red tape. They were issued to the officer in charge of each gun station and control position, with instructions to open a capsule and give the morphine by mouth to each man severely wounded. The red tape was tied loosely around the neck of each patient as a means of denoting those who had received morphine by this method of administration.

THE SUPPLIES FOR BATTLE DRESSING STATIONS

The supplies and equipment for battle dressing stations will obviously vary considerably with the size and type of ship and a consideration of the probable needs will suggest the items required.

It must be presumed that the majority of casualties, when received at the battle dressing station, will have had an occlusive dressing applied at the local aid station and the first consideration will be to make the patient as comfortable as possible, to prevent shock, and to furnish the patient with a comfortable place for recumbency, awaiting such time as re-dressing or surgical measures may be attempted.

The supplies should include articles necessary for the treatment of shock, bedding and linen, anesthetics (local and general), surgical instruments and appliances, surgical dressings, splinting material, antiseptics and disinfectants, with containers for solutions of same, preparations for treatment of burns, stimulating drinks, and nourishment, and the necessary clerical supplies.

Pugh (42) has given a complete list of equipment and supplies recommended for the storeroom of battle dressing stations and reference should be made to these data. This medical officer also describes a "clerical box" which is designed as a portable desk, for use at battle dressing stations, and contains papers and other clerical material necessary for transfer of casualties direct from the dressing station to hospital ships, or nearby shore hospitals. The contents include stationery and writing material, medical history sheets, battle station casualty reports, blank forms "F," "G," "K," and "N" of the Medical Department, United States Navy.

Rixey (19) advises against the use of glass containers in battle dressing stations except those protected by wicker work.

The items of field equipment (items Nos. 1 to 7, inclusive, of the Field Supply Table, Medical Department, United States Navy, 1923), carried on board the larger ships may be advantageously utilized as a reserve in case of depletion or destruction of other supplies and equipment.

An allowance of surgical material for each dressing station should be sufficient to treat 20 per cent of the complement as wounded. This allowance provides surplus supplies in case one of the stations is destroyed in action. The records of modern naval warfare contain several instances where supplies of one dressing station were destroyed by shell fire. (Fig. 4.)

All the supplies in the forward dressing station of a British battleship at Jutland—presumably the *Barham*—were destroyed by a shell explosion.

The after dressing station of the *Warrior* was wrecked, the surgeon miraculously escaping.

A distributing station of the *Tiger* was demolished, and the ship suffered 44 per cent of casualties in the medical personnel.

The possibility of medical stores being ruined in mass by a collision or other accident should be anticipated. The accident to the *McFarland*, mentioned elsewhere in this article, shows the necessity of making provisions in case of a similar occurrence happening in times of peace.

In a collision between the *Montague* and *Manley*, several depth charges exploded, blowing off the stern of the latter ship up to the after torpedo tubes. This accident caused 56 casualties—34 killed and 22 wounded. The *Shaw* was rammed by the *Aquitania*, which resulted in cutting off clearly the bow of the *Shaw* just forward of the bridge. Twelve men were killed and 15 injured.

Such accidents as these prompted the Surgeon General of the United States Navy, in his report of 1919, to recommend that medical stores be divided, one portion kept forward and one aft. "In several instances the entire medical outfit was destroyed. There should be kept on deck in easily accessible places, such as the forward and after deck house, two small first-aid outfits. Small weatherproof lockers could be provided for the purpose."

Transportation of Wounded on Board Ship

Devices for Transportation of Wounded on Board Ship

From a review of the literature on this subject it would appear that authorities unanimously agree that hand transportation of the wounded on board ship during action is preferable—except in special cases—to the use of the various types of naval litters, stretchers, cots, or other devices.

The Japanese, during their war with China, found "that stretchers of all kinds were cumberous and troublesome" during action, and "hands alone were therefore employed on board the ships, and the stretchers were laid aside * * * therefore ships' crews should also be drilled in this method of conveyance."

In the Russo-Japanese War the Russians found the regular litter to be of little value for conveying the wounded to the dressing station, and the wounded "were simply picked up by men detailed for this purpose and carried below" (Spear) (43).

In this war, the Japanese resorted to hand-carrying the wounded to the action station and "almost never was any form of stretcher used" (Braisted) (44).

Pasquale says that "for the purposes of transporting the wounded during an action, all kinds of stretchers and similar devices, no matter how ingenious they may be, have little or no practical value."

Litters "do not play an important rôle in the transportation of wounded except to hospital or for land purposes, and even then the type of litter is of secondary consideration."

In the World War, on one ship at least, "stretchers were found useless on board," and another authority states that "probably no form of mechanical transportation has proved equal" to manual transportation of the patient.

Among the numerous devices designed to facilitate the transportation of naval wounded the following are mentioned, some of them as a matter of historic interest only:

Rosati-Campanile slings.	McDonalds hammock.
Gorgas cot.	Guezanne hammock.
Wells cot.	Ames stretcher board.
Gibson cot.	Furley stretcher.
Auffrets goutieres.	Lung apron stretcher.
Mowl carrying chair.	Stitt litter bar.
Thibaudier S-shaped chair.	Kimura bearing band.
Wise litter.	Mason hammock stretcher.
Lowmoor jacket.	Rho flexible seat.
Fiorana stretcher.	Roselli immoblizing canvas.
Yashida stretcher.	Stokes stretcher.
Giura seat stretcher.	Totsuka stretcher.
Pasquale seat stretcher.	Neil Robertson stretcher.
Coleti aprons.	Kirker sleigh.
Miller litter.	

Summing up, Barthelemy (45) says: "The wounded able to walk go by themselves or with a hospital corpsman to the battle hospitals. The wounded that are unable to stand are conveyed by the arm method. Only the gravely injured, those having fractures of the legs and body, are carried in litters."

It seems, in spite of the amount of study given the question, that no one type of litter fulfills all the requirements of naval service, yet "one can not despise or neglect them, for there are serious inconveniences in the transport of wounded by arms only, and the severely wounded should always be carried on the stretchers."

It would appear advisable, especially on the smaller vessels, to plan upon the use of canvas litters arranged in tiers to increase the bed accommodation for the wounded after battle. This brings up the question of the allowance of stretchers and litters on ships of the United States Navy. It is believed that 12 Stokes stretchers and 8 canvas litters is not too large an allowance for a battleship of 1,200 men.

The British during the World War increased the allowance (according to N. S. 3266015–18.2.1916) of the Neil Robertson stretcher to one for each turret, control top, engine room, and boiler room, and two for each distributing station of capital ships. Smaller vessels were allowed one for 2 per cent of complement. This is in addition to the type used for landing parties and shore work, the allowance of which was one for 2½ per cent of complement.

The Japanese Navy has adopted the Totsuka stretcher which is presumably the original type of the Neil Robertson bamboo stretcher now used in the British Navy. The Totsuka (window-blind bamboo) stretcher was invented by Surgeon General K. Totsuka of the Imperial Japanese Navy, and issued to each vessel of this navy during the Russo-Japanese war.

In the British Navy three types of stretchers are in use—the Furley stretcher, which is similar to the United States Army litter; the bamboo and canvas stretcher, which is shorter; and the Neil Robertson hammock, which has the advantages of "lightness, strength, flexibility, compactness, and protection to the patient." (46).

Fisher reports a case of fractured femur, who was thrice transportated in this stretcher before the limb was finally set in splints, yet the patient suffered only slight discomfort and no sign of shock appeared.

Darby reports the Neil Robertson stretcher as "most useful, and well adapted on ships with steep ladders, small hatchways, and narrow passages." According to another writer, "none better or more suitable can be imagined."

The official stretcher of the United States Navy is the Stokes splint stretcher, the structural details of which will probably be modified in the near future, the details of the modification being in the form of Federal specifications. Among some of the proposed changes are—

(*a*) Tubular construction—the specifications requiring airplane steel.

(*b*) Welding the transverse braces to longitudinals in place of the present method of riveting, which method causes at least 30 per cent loss in the rigidity of the litter.

(*c*) Rounding of the perineal ridge of the stretcher.

(*d*) Elimination of sanitary opening.

(*e*) Substitution of gluteal straps for foot pieces to steady the patient when litter is in an inclined position.

It is believed that these changes will result in a stretcher of twice the rigidity of the present one and will increase its life over 100 per cent. Credit is acknowledged to the United States Army for priority in making some of these innovations in the development of an airplane litter. Blackwood, in a communication dated October 8, 1917 (Bureau of M. and S., file No. 124, 704–40), recommended the substitution of steel pipes for metal rods. He also called attention to the fact that in riveting the cross rods to longitudinal rods, a hole about three-sixteenths of an inch in diameter was drilled in each rod, which destroyed two-thirds of its strength, and for this reason recommended that welding be substituted for riveting.

Attention is called by Bell to the fact that the Stokes type of stretcher is less liable than some of the other models to constrict the chest of a wounded man and thus interfere with respiration, which is an important point for consideration in those cases suffering from shock.

Bogert (47) speaks very favorably of the use of the British "canvas carrying cot," as it prevents or lessens shock by reducing the handling of wounded evacuated from combatant ships. By this method the wounded man after being dressed is placed in a cot, and remains in it until he reaches the naval hospital; the device serves in dual capacity as a bed and a litter.

Blackwood describes a detachable bunk for wards of ships, which can also be employed as a litter to convey patients about the wards.

Russo and Pasquale have developed a demountable wheeled stretcher weighing 21 kilos, which is useful for naval landing parties, as the dismounted apparatus will fit in two bags which are carried on the backs of litter bearers like a haversack. It is believed that a hand traction ambulance—a two-wheeled litter carrier—could be developed and advantageously utilized by the United States Navy.

An ambulance sling has been developed by Boyden (48), designed for a one-man carry of patients, not too severely wounded, up or down step ladders. (Fig. 5.)

The installation of canvas chutes for lowering the wounded between decks eliminates the possibilities of the stretcher bearers stumbling on the steps of the ladder while the ship is rolling and appears to be an expedient of value. Harman (15) states that canvas chutes were rigged on the *Newark* during the Spanish-American War; Simons (15), on the *Iowa* in 1898, appears to have developed independently a similar device. In case it should be desired to use the ladder for other purposes, the Germans constructed the chute one-

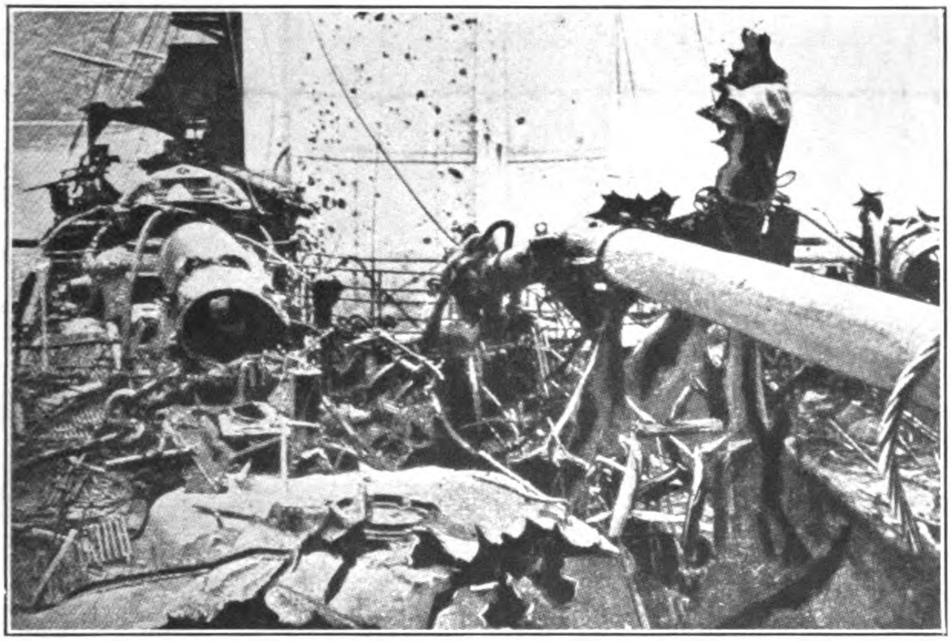

FIG. 3.—BOAT DECK OF THE RUSSIAN SHIP "OREL" AFTER THE BATTLE OF JAPAN SEA, MAY 30, 1904, ILLUSTRATING THE DIFFICULTY OF GIVING FIRST AID TO THE WOUNDED. (BRAISTED)

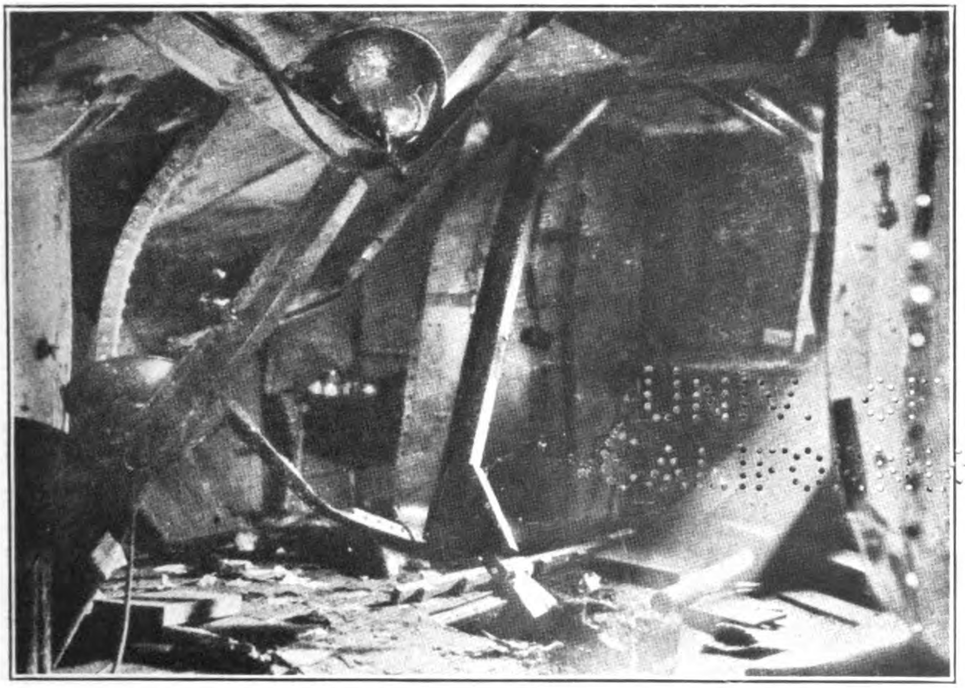

FIG. 4.—A BATTLE DRESSING STATION DAMAGED IN ACTION. (STEPHENS)

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FIG. 5.—"ONE MAN CARRY" OF A PATIENT BY MEANS OF AN AMBULANCE SLING DEVISED BY FLEET SURGEON P. H. BOYDEN, M. D., R. N.

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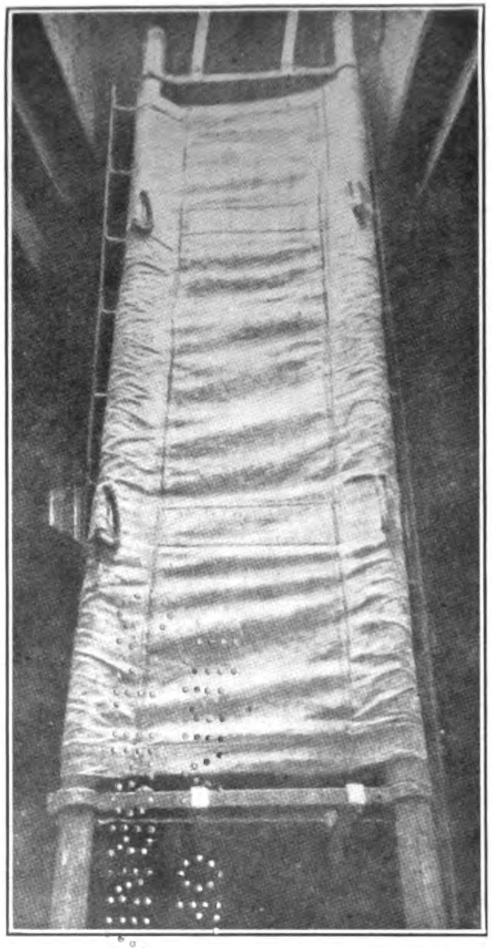

FIG. 6.—INCLINED STRETCHER FIXED IN A HATCHWAY BETWEEN DECKS (VERRY)

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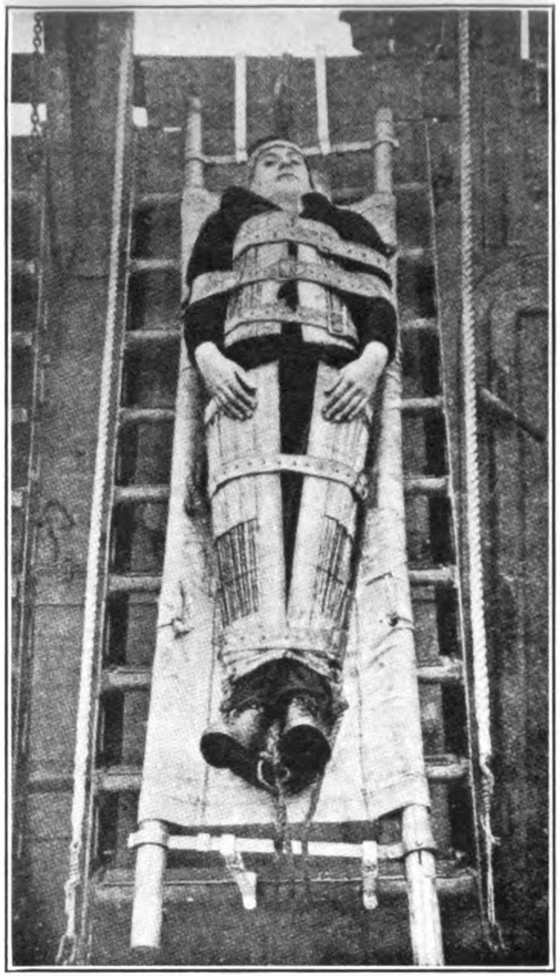

FIG. 7.—CANVAS STRETCHER RIGGED AS A CHUTE IN A HATCHWAY. PATIENT IS SECURED IN A NEIL ROBERTSON STRETCHER. (VERRY)

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FIG. 8.—CASE A. CORDITE BURN OF FACE

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FIG. 9.—CASE A. SEVENTH DAY

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FIG. 10.—CASE A. AFTER THREE WEEKS. SKIN GRAFTS

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FIG. 11.—CASE A. TWO YEARS AFTER INJURY

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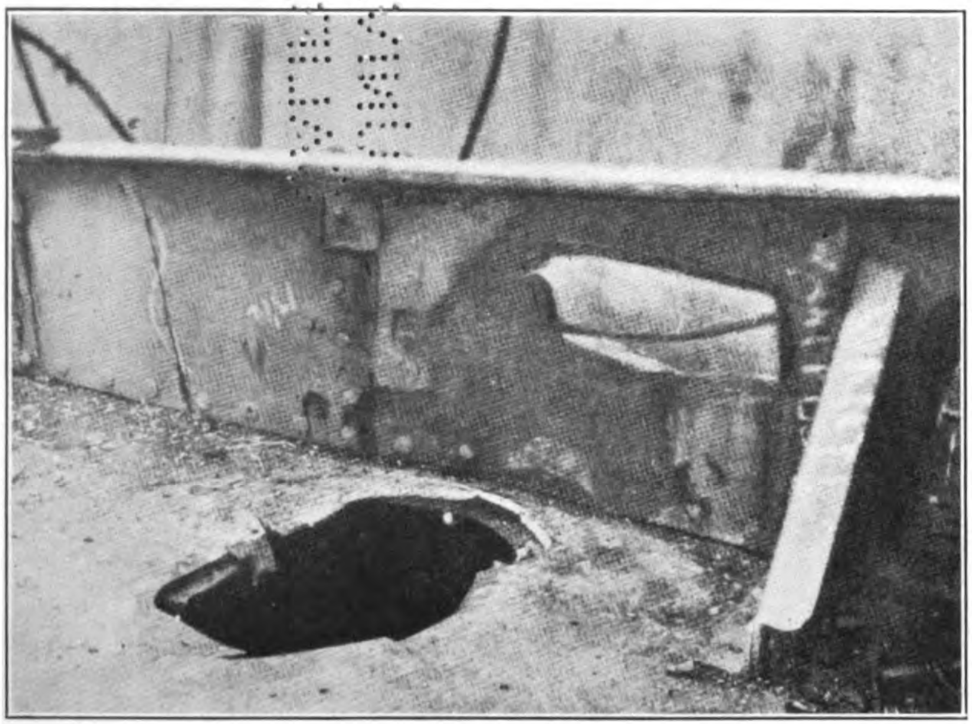

FIG. 13.—ILLUSTRATING THE MODE OF ENTRANCE OF A HIGH EXPLOSIVE SHELL WHICH WRECKED A BATTLE DRESSING STATION SITUATED "BEHIND ARMOR"

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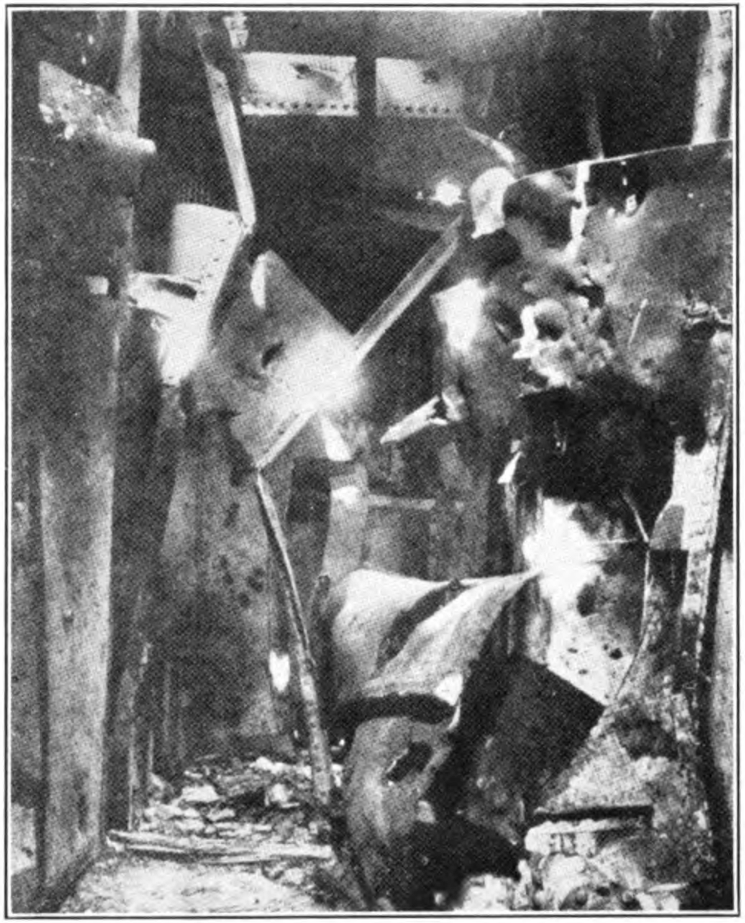

FIG. 14.—THE RESULT OF THE EXPLOSION OF A SHELL BETWEEN DECKS. THIS ILLUSTRATES THE DIFFICULTIES OF TRANSPORTING WOUNDED THROUGH DAMAGED AREAS. NOTE THE IMPRESSION ON STEEL MADE BY FLYING FRAGMENTS OF VARYING SIZES

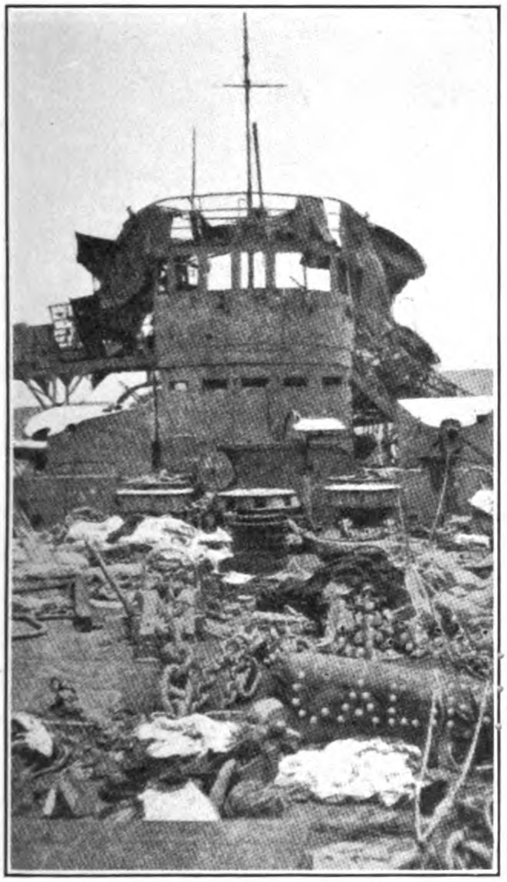

FIG. 15.—WRECK OF THE LIGHT CRUISER "EMDEN." VIEW FROM THE BOWS, LOOKING AFT, ILLUSTRATING THE MEANING OF THE TERM "DÉBRIS" WHEN APPLIED TO WARSHIPS. (SURG. LIEUT. G. D. G. FERGUSSON, R. N.)

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half the width of the ladder, permitting the other half to remain open to passage of the ambulant cases. The canvas chute was found by Holmes to be a rapid and satisfactory method of handling the wounded of a light cruiser during the Battle of Jutland. A description and illustration of this type of apparatus will be found in the United States Naval Medical Bulletin, July, 1917, page 371.

Verry (49) has suggested that the ordinary canvas litter made fast to the steps of a ladder can be utilized as an improvised slideway or, in case the ladder is unshipped for action, it can still be rigged in the hatchway between decks by using certain additional fittings. (Figs. 6 and 7.)

On some of the modern naval ships, electric elevators have been installed for the transfer of patients between decks.

AMBULANCE PARTY

The official instructions during the American Civil War designated four men of each gun division as "aids to the wounded," whose duty it was to remove the wounded to the cockpit. These men were specifically designated in order that more important men in the gun crew would not leave the guns for this purpose.

Messmen, cooks, stewards, landsmen, fire brigade, and rope repairers were assigned by the Japanese as carriers of the wounded during action. This force amounted to 5 per cent of the complement.

Farenholt believes the ambulance party is not so necessary during action as formerly on account of the structural details interfering with their function.

Urie (50) suggests that the term "relief corps" be applied to the group of men detailed to assist the surgeon's division during action.

The official instructions of the United States Navy specify that 2 per cent of the ship's complement shall be instructed in transportation of the wounded and, on battleships, the bandsmen are usually assigned for training as an ambulance party.

There is very little for the ambulance party to do during action, but in a lull or after action they should make a careful and systematic search for the dead and wounded, each squad being assigned to definite portions of the ship. Should the structural design of the ship permit the stretcher squads to visit certain positions of relative security during action for the purpose of collecting casualties, it is a question for the local authorities to decide whether the circumstances warrant this risk of losing trained assistants whose service will be more needed after action.

The Manual of the Medical Department, United States Navy, 1922, specifies the position of the ambulance party during action to be at the bottom of access hatchways near battle dressing stations.

It directs that the relief parties be instructed not to go on deck or in turrets while battle is progressing. The British instructions state that there is a strong consensus of opinion against the practicability of removing wounded to a place of shelter during action.

It should be quite apparent from reading the following description of the training and functioning of ambulance parties on board, that careful study and much effort was given by this surgeon to developing the details of this phase of medical activity.

The following is presented:

"There are six stretcher parties, each party consisting of three men; the senior rating is provided with a first-aid bag and is responsible for the work done by his party. These men have all been through a very prolonged and thorough course of first-aid training and are highly efficient. Above everything they have been taught how to handle seriously wounded men quickly and carefully in the most awkward positions, how to transport without risk of injury, how to lower a patient in a bowline on a bight, how to rig a whip and tie seamanlike and secure knots in the fall and the tail block, to pass a rolling hitch so that the stretcher may be safely lowered by an endless fall, the best points for lowering wounded from the upper decks, and to know their ship thoroughly. Not one of these men ever fails to tell you the shortest route available to get to the distributing station from any part of the ship, and should that route be blocked they always know the next quickest. Competitions are regularly held to find out who can do the work most quickly and thoroughly, and there is a very healthy spirit of rivalry in carrying out this evolution. * * * On a board in the station are painted wooden tallies numbered 1 to 6, corresponding to the numbers of the stretcher parties. A chief petty officer is in charge of the ambulance parties, and when a summons comes by messenger or telephone he removes the number of tallies he considers necessary and hands them over to the senior ratings of the corresponding stretchers. On their return with the wounded the tallies are given up and replaced on the board. In this way a glance at the board will reveal what stretcher parties are out and how many are still available. This arrangement has proved very convenient" (Muir) (16).

Wounds of Naval Warfare

A knowledge of the characteristics of naval wounds and the type of casualties to be expected is essential to the formulation of plans which will contribute to the success of the combatant unit. It is, therefore, considered that a discussion of the wounds of naval warfare in their relation to personnel losses would not be a digression from the subject of naval medical tactics.

Redondo classifies the characteristics of wounds in modern naval warfare by (*a*) their great extent, (*b*) their multiplicity, and (*c*) the frequency with which fragments of missiles, portions of clothes, and other foreign bodies are embedded in the tissue, nearly all wounds being septic. To these characteristics may be added (*d*) frequency of burns and (*e*) absence of tetanus.

Totsuka says that the naval wounded present on the average about two wounds each. Braisted and Suzuki mention an instance where the number of wounds in one patient amounted to over 100.

In observing the Spanish wounded in the naval battle of Santiago, Concas y Palau (13) says nearly every man wounded had at least two wounds and some as many as 10 to 14.

A naval medical officer in the World War says that 20 seriously wounded men represent 60 extensive wounds.

The wounded of the *Vindictive* in the action of Zeebrugge on April 22–23, 1918, showed 135 cases of single wounds and 181 cases of multiple wounds.

Fisher found that incised wounds, except of the scalp, were very uncommon, and, as a general rule, all wounds resulting from naval shell fire, whether perforating, penetrating, or superficial, were lacerated.

Fragments of projectiles traveling with high velocity cause deep lesions, characterized by devitalization of tissue, which is regarded as a condition more dangerous than the presence of foreign bodies, inasmuch as in such dead tissue the septic microorganisms grow with marked rapidity. So it is regarded as imperative that primary operative procedure be adopted, if only to remove devitalized tissue. Debridement removes the source of infection and leaves in the wound tissue capable of resistance and immediate repair. Left alone, practically all shell wounds of naval warfare become septic. Stokes states that every shell wound treated on the *Solace* off Santiago was infected.

A few contused wounds have been reported in modern naval battles, produced by the force of the explosions throwing men against bulkheads or caused by falling débris.

Most wounds are of the contused and lacerated type, resembling the wounds found in industrial centers from machinery accidents. "A noteworthy phenomenon is the manner in which large jagged pieces of shell are able to pass through such small entrance wounds in the skin. The superficial tissues appear to come together in an attempt to bury the foreign body. The track of the fragment appears as though seared by a cautery, the muscular bellies being colored a deep-brown tint. No doubt the tendency to primary hemorrhage is checked by this factor. The high temperature of

in such a short space of time his features could not be recognized owing to the edema. To what extent this was due to the terrific heat, the pressure of the blast, or the irritant chemical must be left to conjecture" (8).

On the *Matsushima* 4 men were burned by the explosion of a 30.5-centimeter shell, and in addition, 55 others were burned by ammunition ignited by this explosion. Twenty-five of these cases proved fatal. The total number of burns on Japanese ships at Yalu amounted to 78 cases.

The lesions from burning cordite were more extensive, affecting the exposed parts of the body, and in 15 cases the trunk was also burned. (Figs. 8, 9, 10, and 11.)

In a series of 206 burned casualties of the World War treated in one of the shore hospitals 126 cases were due to flash of shell explosion and 80 cases due to burning cordite.

Penfold (54) reports a flash from an explosion on an upper deck passing down the trunk of a ventilator and burning men below. Fairlee mentions an incident—when the *Britannia* was torpedoed on November 9, 1918—of the flash of a subsequent explosion traversing the mess deck and causing burns of 46 men.

Rope burn is a form of naval injury noticed in rescued survivors of sunken ships, Hingston (55) reporting over 200 cases of burns of the palms of the hand caused by sliding down a rope.

A rather curious phenomenon was noticed by Mackenzie (56) in two cases of naval wounded. On separating the edges of the wound a small flame shot out, accompanied by an odor resembling acetylene. The cause was traced to small pieces of calcium phosphide, the equipment of a life buoy, which were driven into the wound at the time of injury. This chemical was probably acted upon by the water of the body tissues, and a flame was produced when the edges of the wound were separated and air thus permitted to come in contact with the phosphide. In one of the cases the flame could be repeatedly made to eject itself several hours after death.

Only six cases of scalds occurred among the British personnel at the Battle of Jutland. This number is so small that the objection against using steam for heating the sterilizers in battle dressing stations because of the alleged danger to the wounded from bursting pipes does not seem well founded.

Regarding the disposition of the wounded, Surgeon General Suzuki reports that 82.07 per cent of the naval wounded were returned to stations aboard fighting ships, either during the same or subsequent battle, and of these 51.86 per cent were treated aboard their ships and 30.21 per cent were treated in hospitals.

Penfold found that out of 20 of the recovered wounded who were returned to the former ship, 5 were discharged with neurasthenia,

and the others suffered from this disorder to a greater or less degree. It would appear advisable, as a general rule, to return the wounded to duty on ships other than those on which they received their wounds.

A certain amount of psychic disturbance has been noted in those suffering from prolonged immersion in the water. This was particularly noted among the survivors of the *Amphion*, *Hoge*, *Cressy*, and *Aboukir*, but the writer was at a loss just how much of the psychic shock was due to the explosion, especially among those suffering from wounds, and how much was attributable to the effects of immersion.

Many of the wounded of the Japanese battleship *Hatsuse*, which was sunk by a mine, presented nervous symptoms of anorexia, insomnia, mental agitation, and physical uneasiness. Headache, probably due to cerebral anemia; and nausea and thirst, apparently caused by the swallowing of sea water, were also observed.

Bronchitis and nephritis are common sequelæ of immersion.

Gases from explosions of mines, fumes produced from burning powder—largely nitrous fumes—and suffocating smoke from any source are other causes of naval casualties.

Braisted (44) mentions an incident on board a Russian ship where the entire medical complement—surgeon, nurses, and attendants—were rendered unconscious by the fumes of exploding Japanese shells filled with Shimose powder.

The *Britannia* was torpedoed off the straits of Gibraltar, the explosion starting a powder fire in one of the magazines. In all there were 130 casualties, 50 ending fatally. A large number of the casualties were due to gas poisoning; 56 cases of nitrous poisoning, 10 of whom died, were treated at the naval hospital at Gibraltar. There are reasons to believe that many of the fatalities on the ship were caused by gases containing carbon monoxide.

Some of the fatal cases of nitrous poisoning were exposed to gas for a comparatively brief period. Fairlie mentions two cases: One man attempted to go below to open a fire main, but was unable to go any distance on account of the irritation of the fumes; another man, after coming on deck, started to go below to close a door, but, on account of the fumes, he turned back almost at once. Both of these men died from such brief exposure to the gas.

It was interesting to note that four cases on the *Britannia* had an unusually prolonged latent period of 23 to 29 hours intervening between the time of the accident and the development of the first symptoms of gas poisoning.

Regarding the topographical distribution of naval wounds, the most frequent are those of head, neck, and face, as well as upper ex-

tremities, apparently due to the downward angle of the flight of projectiles. There are a few chest injuries. Wounds of the back and buttocks are comparatively rare.

WOUNDS ARRANGED ACCORDING TO LOCALITY (JAPANESE CASUALTIES, CHINO-JAPANESE WAR) (12).

Locality of injury	Number of killed and wounded	Percentage of killed and wounded according to locality
The whole body	36	15.32
The head (inclusive of the face)	65	27.66
The neck	6	2.55
The chest and back	21	8.94
The abdomen and lumbar region	24	10.21
The upper limb (inclusive of the scapular region)	38	16.17
The lower limb (inclusive of the buttocks)	45	19.15
Total	235	100.00

PREVENTION OF PERSONNEL LOSSES IN ACTION

In the introductory remarks of this paper, the conservation of physical power was accepted as the mission of a military medical department, and hence any measures designed to reduce the percentage of casualties during action have a direct relation to our primary function. The prevention of personnel losses in action is a most profitable subject for medical study and investigation, and one which offers an interesting field for research.

This view of the broadening scope of medical activities will make clear the reasons for a medical officer straying out of the domain of medicine and surgery for the purpose of considering problems which at one time were regarded as not coming under the cognizance of the medical department.

"Traditions die hard," especially in the military service. Only a few generations ago our predecessors served as ship's barbers or were physicians of little military value to the organization, and even to-day the military value of the naval medical department is only beginning to be realized. A bright heritage awaits our efforts, which can only be achieved by the constant endeavor of medical officers to-day to prove their value as a military asset to the service and by united effort in resisting reactionary influences; for each succeeding conflict demonstrates, more and more, the influence of military medicine on tactics and strategy. Indeed, it was the conversion of the principles of modern preventive medicine to military use that made possible the prolonged duration of the World War, as in preceding wars the large number of deaths from disease hastened the termination. Longmore—cited by Stokes (57)—

writing prior to the World War, says that the history of conflicts of any duration occurring during the previous 200 years shows, almost without exception, that at least four men perished from disease to every one killed by the enemy.

Two opposing fleets in action may be pictured as each trying to gain the supremacy by two primary measures:

(a) Destruction of enemy's matériel—its mechanical power.

(b) Destruction of enemy's personnel—its operative power:

(1) Killing and wounding.

(2) Temporary incapacitation; e. g., by lachrymators.

(3) Demoralization.

As an extreme example of complete destruction of matériel with comparatively little impairment of physical power beforehand, the sinking of the British battle cruisers at Jutland may be cited. In a recent issue of a popular lay periodical, a hypothetical case was recorded of a warship steaming through a cloud of poison gas, resulting in a complete loss of man power except for one man in the fire-control top. The possibility of such an occurrence may be used as an example of extreme loss of personnel with no diminution of mechanical power.

Heavily armored ships have been defeated, although their armor was scarcely penetrated. Such was the case of the Chinese ships at Yalu, and the Russian ships at Tsushima, which owed their defeat to a breakdown in morale caused by the effective gun power of their enemy. (Stirling.)

During a naval action in the Russo-Japanese War, the shrieks of a wounded man—his thigh pinned by a jagged iron plating in a fighting top of a cruiser—seriously distracted if they did not actually demoralize the guns' crews on the upper deck. (Bell.)

PROTECTION AGAINST SHELL FRAGMENTS

A ship under fire should be thought of as a space containing (potentially) large numbers of missiles in motion, the missiles being of varying sizes, shapes, and velocities. The general course of these is in the direction away from the enemy, and, if the firing is at long distance, in a somewhat downward direction.

Stokes (57) has shown that the fragments of a bursting shell form a cone with the base toward the unengaged side, a phenomenon which gives this side the larger danger area. (Fig. 12.) Hence, unless there is some intervening protection amidship, the wounded are in less danger on the engaged side of the ship. A thin bulkhead, lockers, hammocks, or other shield will tend to stop many of the smaller missiles and others with low velocity, with special reference to secondary missiles.

According to Hewitt (58), the danger zone, so far as life is concerned, seems to be limited to the small area in the immediate neighborhood of the bursting shell. The initial velocity of fragments seems to be great but appears to diminish rapidly.

Suzuki, having in mind the effect of secondary missiles, says that in preparing a ship for action everything should be removed from the upper decks except what is absolutely indispensable or useful for protection. In support of his position, he cites an instance occurring on board the *Mikasa* during the battle of the Yellow Sea when a semaphore—which could have been removed—was struck by a shell, resulting in the fragments and splinters killing or wounding 23 persons.

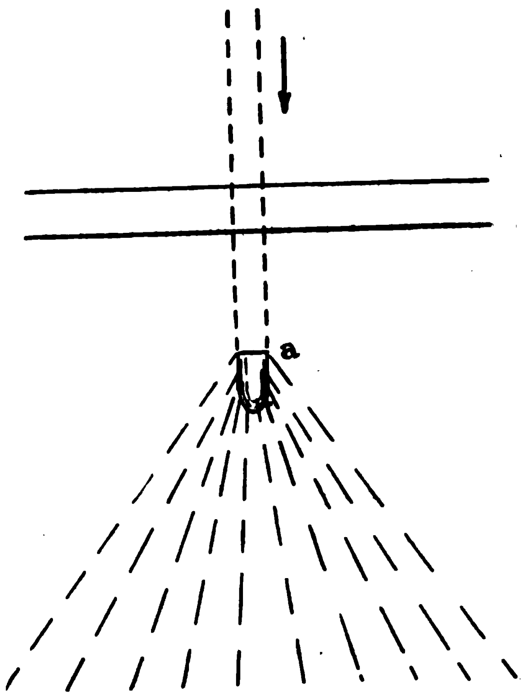

FIG. 12.—Diagram illustrating the effects of a bursting shell. Off Santiago a gunner of the *Texas*, standing in the vicinity of "a," was severely burned by the flash of a bursting shell, yet entirely escaped injury by fragments. (After Stokes.)

Splinter mats — specially constructed mattresses — or, in lieu of these, the ordinary mattress, may be used to prevent personnel losses in exposed positions, such as the bridge, searchlight platforms, and tops (Bell). Screens of wire rope may be used in open spaces of the deck to limit the spread of shell fragments.

In the war with Japan the Russians used a strong bulwark composed of woven steel hawsers placed transversely on the gun deck, well forward, so as to stop the fragments of any shell penetrating the bow of the ship. The same sort of device was placed longitudinally in open spaces between the starboard and port batteries. Sand bags were also used to protect the gun crews. (Spear.)

In this conflict the Japanese made similar efforts to prevent casualties from flying fragments of shells. Gun crews were protected by hammocks and festoons of hawsers. Hawsers were hung in open spaces between starboard and port batteries. On the bridge deck open spaces were protected from flying débris by using old torpedo wire netting. Chains were used to protect the vulnerable parts of the engine-room hatches and uptakes. (Braisted.)

Suzuki mentions an incidence on the gunboat *Chokai*, where a shell burst near a battle dressing station, yet the fragments were prevented from entering by thick canvas screens.

Hewitt (58) cites a case of a wound of the carotid and jugular vessels, caused by particles of shell so small that they probably could have been stopped by a linen collar. Small fragments of shell caused the loss of vision in four eyes, in members of his vessel, which could have been prevented by using motor goggles, the use of which he recommends for captains of destroyers, navigators, and others occupying exposed positions.

It may be accepted as a principle that the wounded should be left on the engaged side out of the way of the guns' crews, unless a sheltered position is available on the disengaged side.

Spear, considering means and measures for the reduction of personnel losses, has made a most interesting observation and it is doubtful if the value of this has been fully appreciated.

He has shown the excellent results obtained by preventing unnecessary exposure of the crew during action by comparing the casualties of two sister ships—the *Gromoboi* and *Rossija*, of the Russian Navy—in the naval engagement of August 14, 1904. "The *Rossija* was hit really more than the *Gromoboi*, but suffered less in wounded and killed because men were not exposed any more than necessary." The hits on the *Rossija* totaled 28 and on the *Gromoboi* 22, excluding hits on superstructure and decks, as given in Official History of the Russian-Japanese War (29).

The *Gromoboi* losses were 70 killed and 300 wounded; the *Rossija* lost 57 killed and 150 wounded, making a difference of 163 casualties which can be attributed to the fact that the captain of the *Rossija* had ordered all men not actually engaged in the long-distance firing—i. e., crews of the secondary batteries—to remain in sheltered positions below.

PROTECTION AGAINST FIRE AND GAS

Muir states that personnel losses from the burns of the momentary flash of a bursting shell can be prevented by even the flimsiest kind of clothing. Also partial protection from burning cordite or woodwork can be obtained by the use of specially prepared clothing. He recommends that fire and ammunition parties be equipped with some form of helmet and gloves—the Ede helmet and Fearnought gloves—in order to reduce the number of cases of burns. Lying flat on deck serves to lessen the effect of fires on the personnel.

The Manual for the Medical Department, United States Navy, 1917 edition, recommends that undergarments be soaked for five minutes in a solution of 1 pound of ammonium phosphate to 2 quarts of water in order to reduce the inflammability.

According to Bell, the British, as a result of the experience of the Battle of Jutland, have adopted flash-proof clothing which is made of heavy wool and treated with a fire-proof mixture of 1 pound ammonium phosphate and 2 pounds ammonium chloride added to 1½ gallons of water.

For defense against the fumes of burning powder, smoke, and other gases, gas masks can be used. The Germans at the battle of Jutland found the use of gas masks very effective against suffocating gases. Muir supplied respirators in the form of gauze stuffed with cotton waste which had been soaked in the "usual soda solution."

Prevention of losses from chemical warfare, used as a naval weapon, is a subject requiring detailed study by the medical and other departments (provided the employment of the same is not prohibited by international agreement).

PROTECTION OF EAR DRUMS

Measures should be undertaken to defend the ear drums against the concussion of exploding shells and firing of guns. Cotton impregnated with vaseline may be used for this purpose, and Borrett (59), who says that ordinary cotton wool tends to "ball in the auditory canal," recommends that lamb's wool, which forms a compressible, permeable medium, be used as a protection against gun blast. This material does not interfere with ordinary sounds and radio operators are able to carry on their duties with it inserted in the external canal of the ear.

Stephens reports that Cheatle's mixture of modeling clay and cotton wool is satisfactory and among the mechanical contrivances for protection of ear drums he regards Elliott's, Ward Cousin's, and Mallock Armstrong's devices as suitable.

Bell (60) believes that the device known as the British "Tommy" is the most satisfactory type.

PREVENTION OF LOSSES FROM DROWNING

Measures taken to prevent drowning may be divided into (*a*) individual and (*b*) collective. The ordinary jacket preserver is an example of the former, while life-preserving rafts and floats are examples of the latter.

The Russian sailors in the Russo-Japanese war were provided with mattresses filled with fine pieces of cork, provided with canvas bands attached in such a manner as to facilitate their use as life preservers. This arrangement proved the means of saving a number of Russians from drowning.

The use of buoyant litters in debarking the wounded should be considered. Sinclair has described air chambers which may be attached to the Stokes stretcher to render it buoyant with a patient secured in it. Hingston discovered, accidentally, after a patient suffering from a compound fracture of the lower extremity had fallen over the side, that the Neil Robertson stretcher was capable of supporting a patient in the water.

The methods of preventing drowning in naval warfare will be more extensively considered in the succeeding installment of this article, in the discussion of the proposed use of "rescue" ships as a specialized type of hospital ships.

Evacuation from Combatant Ships

"The guns are silent; the naval battle is finished; the two adversaries are finally separated from each other, with damages more or less severe. On board, the doctors have completed their overwhelming work. * * * What should we do with all the wounded now, a great hindrance to the efficiency of the ships? Here, as at many other points, the necessities of war go hand in hand with the laws of humanity. These wounded it is necessary at any cost to disembark." (Barthelemey.)

It is advisable to think of two opposing forces in battle as constantly striving to obtain every point of advantage and, as a corollary, endeavoring to prevent the adversary from adopting favorable procedures and forcing him to accept points of relative disadvantage.

One of the important measures to secure the prompt restoration of fighting efficiency of a ship after battle consists in the removal of battle casualties. Failure to evacuate the casualties is recognizable as a handicap.

Other factors being equal, the fleet able to accomplish prompt evacuation of the sick and injured from warships will be the victor.

The presence of battle casualties on fighting ships decreases the fighting efficiency for the following reasons:

(1) The presence of dead and mangled comrades lowers the morale of the crew.

(2) A number of sick and wounded requires the attention of attendants needed for combatant duties.

(3) Battle casualties occupy space and consume supplies needed for combatants.

(4) Medical supplies and hospital accommodations on board are barely sufficient to care for the casualties of one action.

Prompt evacuation of battle casualties from combatant ships is a military necessity. Not only is the evacuation of the battle

casualties of importance but the continual removal of the accumulation of the "normal sick and injured" contributes to the maintenance of the fighting forces in an efficient state of readiness for action. Penfold in tabulating the lessons learned from the Jutland naval engagement places stress on the importance of evacuating such cases as are quite unfit for duty at their battle station to the hospital ship, if possible, before the fleet goes into action.

Susuki says that the presence of the maimed and wounded comrades seriously interfered with the service of the guns.

The second in command of one of the Russian battleships during the final decisive naval battle of the Russian-Japanese War is the authority for the statement that no less than 140 dead and hopelessly wounded were thrown overboard from his ship, apparently in an attempt to improve the morale of the personnel.

The defeat of the Russian fleet off Tsushima has been ascribed to demoralization of the personnel through the presence of the wounded.

It is useful to consider the general process of evacuating battle casualties with a view to the destination of the wounded, inasmuch as that course helps one to visualize the situation to be met after action and to plan one's organization accordingly.

1. Debarkation (ashore).
   - (*a*) Direct transfer of patient from ship to shore.
   - (*b*) Indirect transfer by use of small boats.
2. Transshipment (to other vessels).
   - (*a*) Direct transfer from ship to ship.
   - (*b*) Indirect transfer by use of (1) small boats or (2) special transshipment devices.

Since, however, the subject of evacuation will be further considered in a discussion of the tactics of hospital ships and shore hospitals, the only phase of the evacuation which concerns us at the present time is the procedure of removal from combatant ships. That may be accomplished by—

(*a*) Individual method.

(*b*) Collective method.

The term "individual method" refers to the removal of patients one by one, while the "collective method" may be used to designate the removal of two or more patients simultaneously by means of the same device, as, for example, by placing wounded in a boat while it is in the cradle, and then lowering the boat so loaded. This method was suggested by Farenholt, who considers it safer and more expeditious than the individual method.

A whip attached by means of a strop to the muzzle of a big gun may be used to transfer patients. The strain is taken on the whip, the gun is elevated and the turret is trained outboard, carrying the

loaded litter with it. By means of the whip and depressing the muzzle of the gun, the patient is lowered into the waiting boat. (Muir.)

In disembarking or transshipping wounded, Muir advises against allowing patients to be carried down the gangway ladder; the gangway or davit is preferable and should be utilized when possible. He recommends that a hypodermic injection of morphine be administered to those likely to suffer en route, and all patients should be given an opportunity to micturate before leaving the ship.

The Japanese found that the wide cargo doors on hospital ships were most useful in the direct method of transfer of patients. The Germans refrained from adopting this means, as they considered that the presence of such doors weakens the strength of the ship.

The direct transfer of patients from warships to the shore or to other ships may be over the ordinary gangplanks or across stationary lighters or floats.

If gangplanks are used they should present good footing in order to minimize the danger of litter bearers slipping and should be constructed with attached handrails. A horizontal gangway, if practicable, is desirable for the ambulant wounded and stretcher bearers carrying loaded litters (61).

By use of a little staging, stretcher cases may be passed direct from one ship to another, provided, of course, that the state of the sea permits this operation.

The act of evacuating the sick and wounded from fighting ships to hospital ships, by the medium of ambulance boats, involves three stages, viz, (*a*) removal from the delivery ship to the ambulance boat, (*b*) transit from delivering ship to receiving ship, and (*c*) removal from ambulance boat to receiving ship. As already mentioned, only the first procedure will be considered at this time.

The delivering ship should assume the responsibility for the transfer of patients to the ambulance boats, while the receiving ship assumes charge of the transportation of the wounded from this point. The medical department properly prepares the patients for evacuation and places them on deck, and some line officer or other person familiar with seamanship should supervise the actual removal from the delivering ship.

Evacuation of the wounded from a defeated vessel is often a difficult task, as is well illustrated in the transfer of 80 wounded from the *Emden* to the *Sydney*. Davits were used on the *Sydney* to hoist the patients aboard, but on the defeated vessel these had been shot away, and because of this loss, and for other reasons, it required four hours to effect the transfer, although every effort was made to complete the task as quickly as possible.

The ship receiving the wounded should be prepared to take charge of the removal of wounded from fighting ships because the damages resulting during the action to the personnel and matériel may prevent the warship from being able to assume this responsibility, as when the ship receiving the *Emden's* wounded was compelled to assume supervision of their removal. It would, then, be advisable for all hospital ships to include in their equipment and in their organization of personnel the necessary provisions to go aboard combatant ships after battle, whenever requested to do so, and take complete charge of the evacuation of wounded. Bell (20) designates those detailed from the hospital ships to warships after action as "humanitarian units," each unit consisting of 6 medical officers and 25 hospital corpsmen.

As a protection from rain, while delivering the wounded, the Japanese made use of a light iron frame work, attachable to litters, over which was placed a rubber blanket.

In case hoisting devices are used for the transfer of patients, they should be manned by experienced personnel and carefully tested before the wounded are slung out. Means must be used to prevent slipping of the transfer gear. Excess swinging of the suspended litter can be prevented by fitting stay lines, controlled from below. (Zur Verth.)

According to Spear, the Russian hospital ships made use of wooden platforms, sufficient in size to hold two stretchers, to receive and transfer patients. The platform was swung clear of the ship and lowered by means of two small cranes worked by steam winches.

Stretcher patients may be placed on larger wooden platforms fitted with guard rails, and the entire contrivance may be hoisted, lifted outboard, and lowered on the deck of another vessel, or patients may be put on shore by this method of conveyance.

The double litter carrier used by the Germans for evacuation from ships, consists of a wooden frame 2 meters long by 1 meter wide, inside measurements. The bottom of the framework is covered by heavy canvas. Hook holes are arranged along the long side of the double litter, and one in the center of each end. In each hole is fixed an eyelet. A hook to which a guide line is fastened is inserted in each hole. A canvas sheet cover, made fast to the sides and center partition, is used to prevent the two patients from falling out in case the litter is tilted while suspended in the air. Zur Verth says that the double litter carrier is saving in time and energy, and obviates the possibility of litter bearers stumbling and falling or slipping while going down ladders or gangways.

Ruddock (62), writing of the transfer of 227 litter cases and 1,570 ambulatory patients from the *Northern Pacific*, then aground, says that it required the combined effort of all on board for a period of three days to accomplish this removal.

"The first man in a stretcher was put over the side about 10 a. m. This method was very unsatisfactory and very slow and required too many men to handle the stretchers, so another method was used. The lifeboats were lowered on the lee side of the ship and secured in line from forward aft by means of lines, and acted as floats, two men being detailed to each boat. One davit for each boat was rigged out and the stretchers lowered into the ship's lifeboats, from which they were taken away by motor boats. No stretchers, however, would be lowered unless boats were available to take them away. This was necessary in order to avoid any unnecessary exposure to the wounded men. They were lowered into lifeboats with gantlines."

Borrett (63) has described a simple cot pole—somewhat similar in principle to the Stitt stretcher bar (64)—for transporting patients

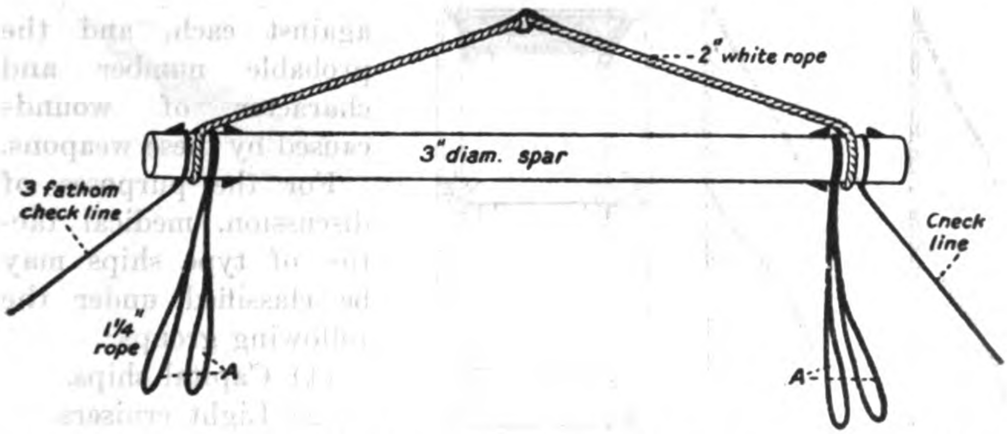

FIG. 16.—A simple cot pole. (A) Loops for handle of stretcher. (Barrett.) (Reproduced, by permission, from Journal of the Royal Naval Medical Service.)

outboard. He finds that the check lines being maneuvered from the receiving ship instead of the delivery ship results in a distinct gain in rapidity of evacuation.

"The following practice evolution was carried out in harbor: Boats available, launch and cutter; 20 severely wounded. Placed in 11 cots and on 9 Mansfield stretchers. The whole collected in sick bay and adjoining forecastle deck. Modified 'Achilles' cot pole (Fig. 16) rigged to smaller derrick each side of quarter deck. The patients were carried aft and swung out rapidly and conveniently, each side of ship simultaneously; the cots and stretchers were placed fore and aft on the thwarts; 8 in the cutter and 12 in the launch. Time actually taken was 22 minutes out and 18 minutes in, but could well be reduced to 15 minutes for the whole evolution, provided weather is suitable."

The device for aerial cable transportation at sea of patients from one ship to another, developed by Stokes in 1898, is typical of its

class. It is similar in operation to the German apparatus (61), which was modeled after the coaling device of Connemann and developed subsequent to Stoke's method. From the information obtainable regarding this method of transferring patients from one ship to another by means of a connecting wire cable, it appears that it would rarely be practicable to utilize it, and little would be gained by such a slow, and somewhat hazardous, method.

Medical Tactics of Type Ships

In formulating the details of medical arrangements for battle, consideration must be given to prospective tactical employment of type ships, their defensive structure, the most likely weapons the enemy may employ against each, and the probable number and character of wounds caused by these weapons.

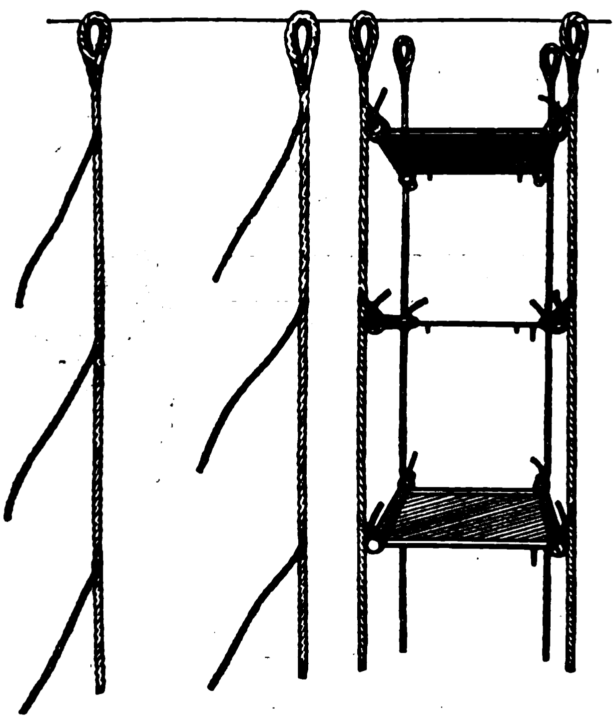

Fig. 17.—Method of using litters to increase accommodations for the wounded. (Reproduced, by permission, from Journal of the Royal Naval Medical Service.)

For the purposes of discussion, medical tactics of type ships may be classified under the following groups:

(1) Capital ships.
(2) Light cruisers.
(3) Destroyers.

The capital ships include battle cruisers and battleships, the latter term being a corruption of the "line of battle ships." The capital ships are the backbone of the fleet—the vertebræ of the naval organism—and the results of the last war indicate that the capital ships still reign supreme. This type of ship may be likened to the infantry—the "doughboys"—in so far as they deliver the maximum effort and receive the brunt of the fighting. With each development in specialized warfare, it at first appears that the infantry and the capital ships will be superseded by other types, but it may safely be assumed that this event has not yet come to pass (and possibly never will). The present indications, however, suggest that a modified airplane carrier, with heavy guns, may be the capital ship of the future, the surmise being mentioned in a speculative

manner, in order that we may not fail to take cognizance of the trend of future naval construction with a view to developing medical tactics in accordance therewith. Airplane ambulances have already demonstrated their value in evacuation of the wounded in land warfare.

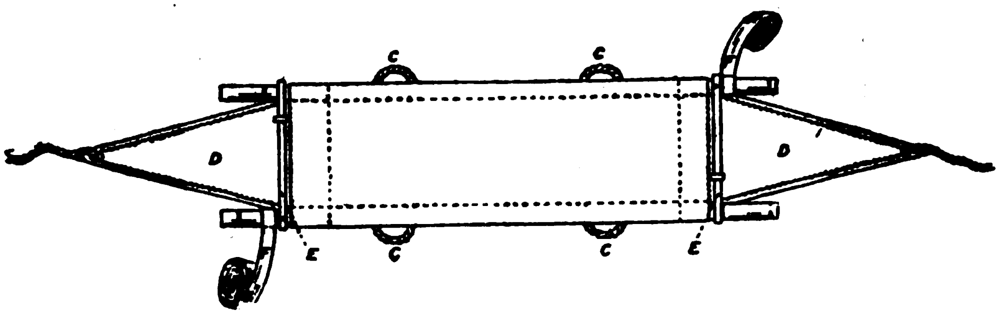

FIG. 18

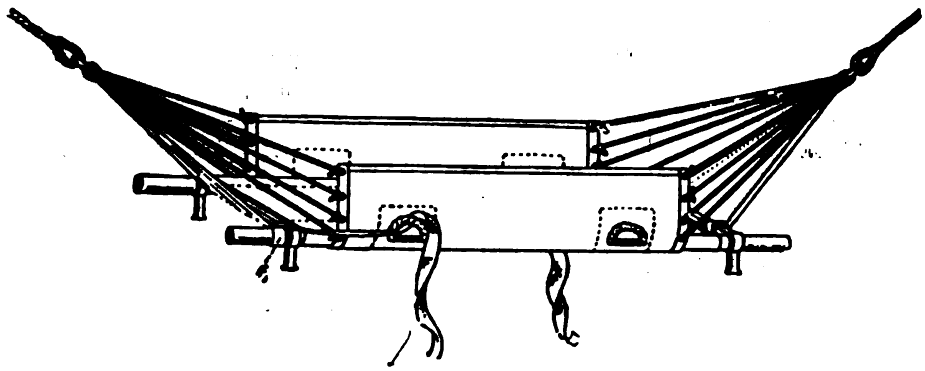

FIG. 19

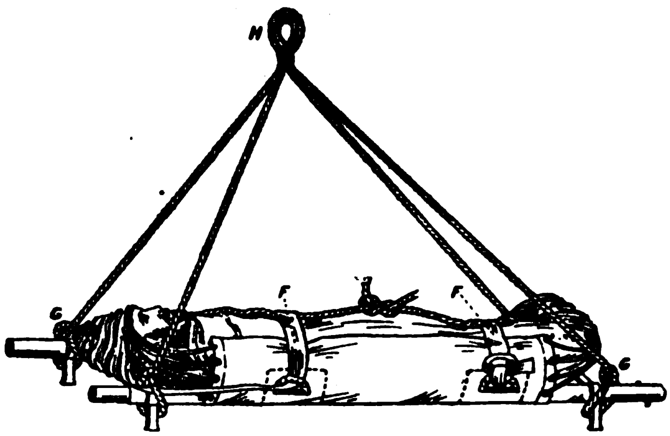

FIG. 20

FIGS. 18, 19, and 20.—An easily improvised stretcher cot using a service hammock with clews and lashings complete. Described by Staff Surg. Henry Cooper, R. N. Canvas triangles added to a canvas litter are shown in Figure 18. (Reproduced, by permission, from Journal of the Royal Naval Medical Service.)

Light cruisers, descendants of the old frigate, are the "eyes of the fleet," and function in the service of security and information. They are light, fast vessels, a standard type of which is now in the process of evolution.

Destroyers may be regarded as small-sized light cruisers, on which all the difficulties of collecting and transporting wounded are intensified by vertical ladders, angular turns, and narrow passageways.

In order to obtain an idea of the character of casualties likely to be encountered on the different types of ship, the subjoined data are presented as a basis for this estimate. This table illustrates (*a*) the frequency of burns among battle injuries on board capital ships, (*b*) their comparative rarity on light cruisers, and (*c*) their practical absence on destroyers.

BATTLE OF JUTLAND—BRITISH CASUALTIES

Types of ship	Killed, drowned, or died of wounds	Injuries				Total injuries	Total casualties
		Wounded	Burned	Combined wounds and burns	Gassed		
Capital ships	3,553	101	156	25	9	291	3,908
Light cruisers	97	153	15	8	0	176	273
Destroyers	229	59	0	1	0	60	289

From the table below it will be seen that the large majority of hits on lighter vessels were from small projectiles, which, being more sensitive, usually detonate on impact, causing casualties in the immediate vicinity of the explosion; hence the majority of killed and wounded on lighter vessels may be expected on the upper decks.

HITS RECEIVED AT JUTLAND

Type of ship	German ships		British ships [1]	
	Large projectiles	Small projectiles	Large projectiles	Small projectiles
Capital ships	[2] 119	18	54	0
Light cruisers	2	14	0	43
Destroyers	0	5	1	16

[1] Only those ships which required dockyard repairs are included.
[2] Includes hits by small projectiles of battle cruiser Lutzow.

Since the Battle of Jutland was not decisive, and the battleships of the opposing fleet were in contact for a comparatively limited period of time, the conclusion that battleships are not likely to be sunk by gunfire is not warranted. The possibility, however, of any type of ship sinking must be kept constantly in mind in formulating our plans for the care of the wounded.

Ships Sunk at Jutland

Type of ship	German	British*
Capital ships	2 (1 battleship, 1 battle cruiser)	3 (battle cruisers).
Light cruisers	4	
Destroyers	5	8

*Exclusive of three cruisers—Black Prince, Defense, and Warrior.

Two destroyers, *Shark* and *V-27*, sank immediately after being hit by torpedoes. One destroyer, *V-4*, was sunk by a mine. Three German light cruisers were hit by torpedoes, the *Frauenlob* sinking immediately with all hands. The *Rostock* was later blown up by the Germans, and the *Wiesbaden* remained afloat some time after being hit by a torpedo; the actual sinking appeared to be caused by gunfire from the Third Battle Cruiser Squadron. The German battle cruiser *Lutzow* was also blown up by the Germans after severe damage had resulted.

MEDICAL TACTICS OF CAPITAL SHIPS

Practically all modern capital ships provide space and equipment for the establishment of three battle-dressing stations, which may be designated as—

1. Principal battle-dressing stations. (Protection is the foremost consideration.)
2. Auxiliary battle-dressing station. (Protection and accessibility are of equal importance.)
3. Third battle-dressing station. (Accessibility and unobstructed space are prime requisites.)

As mentioned before, the establishment of collecting points for the wounded would serve to facilitate the vertical transportation of the wounded between decks and to sort out the slightly injured and thereby prevent them from going below and congesting the battle-dressing stations during a lull or immediately after the battle. Due to the long range of modern naval battles and to smoke screens and factors limiting visibility, the lulls in the fighting between major ships tend to increase in number.

The personnel of capital ships in action may be grouped according to the position they occupy during battle, into four divisions, viz:

(1) Those below the protective deck.
(2) Those below decks but outside protective deck.
(3) Those in turrets.
(4) Those above decks—bridge, fire-control towers, superstructures, etc. (Modified from Pleadwell.)

In presenting the following, attention is invited to the fact that this information—collected from a number of sources—must not be considered a complete tabulation of personnel losses, as in many places it is fragmentary in character. There may be one or two instances of duplication on account of the different manner of reporting the same casualties.

It is impracticable to follow accurately this system of grouping personnel casualties of capital ships according to the location of their occurrence on board, and perhaps more accuracy could have been obtained if the casualties had been assembled according to the location of hits causing the personnel casualties; for example, (*a*) hits on armored portions of the ship, (*b*) hits on casemate armor, (*c*) hits on unarmored decks and superstructures, etc. Unfortunately, this type of information was not always given, so the former system of classifying casualties was adopted.

(1) *Casualties below the protective deck of capital ships.*—The protective deck was not penetrated at Jutland by gunfire except in the case of the *Seydlitz*, which was pierced by shell fragments, resulting in a quantity of water entering the ship. All engine and boiler rooms, except the *Seydlitz* boiler room, remained intact (Frost) (13).

The armored engine-room grating on the *Von der Tann* proved sufficient to prevent injury to the personnel below.

The complement situated below the protective deck is peculiarly subjected to damage from gases, smoke, and powder fumes, which enter through the ventilating system. The importance of providing the crew of the machinery spaces with gas masks is illustrated aboard one of the German capital ships at Jutland when the main engine room was filled with asphyxiating gases, yet, by means of gas masks, casualties were prevented and the men were able to remain at their station until the compartment was freed of gas.

What protection the mechanical arrangement of "blisters" on the hulk will afford personnel from the effect of underwater explosion remains to be seen. There is a potential danger to the men located below the protective deck from underwater explosions such as mines and torpedoes.

When the *Russel* was struck by two mines, 17 persons in various parts of the ship developed symptoms of gas poisoning. These appeared in the first patient 4 hours after the explosion, and the last person to be affected noticed the first symptoms 17 hours after the accident. The delayed appearance of symptoms is characteristic of poisoning by nitrous oxide gases.

The *Marlborough* was hit by a torpedo and severe material damage resulted. Although the personnel loss was only two men killed, it required 1,000 men working six weeks to repair the damage.

A second-line battleship—the *Pommern*—was hit by a torpedo, which caused an explosion of the magazine to blow up the ship with the loss of all hands. This vessel was an obsolete type, hence no definite conclusions as to the effect of torpedoes causing personnel losses on modern battleships are warranted.

The *Ostfriesland* struck a mine, resulting in one man being killed and nine wounded.

The *Grosser Kurfurst's* side armor was pierced by three shells, one of which exploded in a bunker, killing one man.

(2) *Casualties below deck and outside protective deck.*—Twelve men were killed on the *Tiger* by penetration of the side armor by an 11-inch shell.

A British battle cruiser was penetrated by two 12-inch shells, one of which wrecked the distributing station, "with many casualties," and the other exploded on the main deck, with "heavy personnel loss."

A 12-inch shell penetrated the side armor of another battle cruiser, killing many of the guns' crews in reserve and salvage parties.

Thirty-two persons were killed or died of wounds on a British battleship from the effects of a shell which also wrecked the forward dressing station and destroyed or damaged the medical supplies.

Out of 32 hits on side armor of capital ships, 6 resulted in no damage. As a general rule the personnel casualties caused by hits on this portion of the ship were negligible when compared to accidents in turrets.

It has been reported that the force of shell explosion has blown an armored door off its hinges, causing it to skid along the deck, injuring the lower extremities of a number of persons.

The first shell to hit the *Barham* came in the starboard quarter, wrecked the captain's cabin, and the point of the shell deposited itself in the captain's waste-paper basket.

Fires are very apt to occur in the broadside battery compartments. On board a German battleship a fragment of 12-inch shell penetrated the deck above, igniting boxes of 6-inch powder charges, burning all members of one gun's crew and several of another.

Two 12-inch shells started a powder fire on the *Malaya*, which spread along the starboard battery, causing 102 casualties.

A 12–15-inch shell pierced casemate armor—6 inches thick—of the *Seydlitz* and killed the entire crew of a 6-inch gun. Another gun crew of the same ship suffered similarly.

The admiral's cabin on the *Princess Royal* was wrecked by a 12-inch shell, resulting in many casualties among the salvage party and broadside crew in reserve. Several men were gassed from this explosion.

The explosion of a 12-inch shell on the main deck of the *Barham* caused numerous casualties among medical and radio parties and broadside crews in reserve.

The sick bay of the *Warspite* was wrecked by a 12-inch shell, which started a fire that lasted four hours. Two 11-inch shells destroyed the sick bay of the *Tiger*.

In the North Sea action of January 24 a 12-inch shell penetrated the distributing office on an upper deck of the *Tiger*, killing six men and wounding five others. This explosion blew up the trap hatch between the distributing office and gun-control tower, causing three officer casualties in the gun control tower. The same projectile killed one and injured three in the port 6-inch gun control.

(3) *Casualties in turrets of capital ships.*—An 11-inch shell penetrated "A" turret of the *Indefatigable* and, supplemented by the effects of another shell of the same salvo, "A" magazine was exploded, which resulted in the loss of the ship.

The *Invincible* was sunk in a similar manner—from hits on the turret causing ignition of powder charges and explosion of a magazine.

The *Lion* was saved from this fate by prompt flooding of the magazine when "Q" turret was penetrated by a 12-inch shell which exploded in the gun house, killing 60 men and putting the turret out of action.

The men occupying a gun house of the *Von der Tann* were killed when a shell penetrated the barbette. A shell penetrated the barbette of the *Warspite*, killing several members of the fire brigade.

In the Dogger Bank action a shell ignited charges in the *Seydlitz's* after turret and wiped out two complete turrets' crews. The Germans profited from this experience by installing asbestos pads on magazine hoists and making certain changes in the stowage of ammunition. At Jutland a shell hit the *Seydlitz* in almost the same place, but caused comparatively few casualties.

A shell struck the "Q" turret of the *Tiger*, blowing a large hole in the roof plate, killing two men and wounding several others. The officers in charge of the turret got a spare crew from below, cleared away the dead and injured, and after a few minutes were able to fire the right gun by using hand loading.

The large personnel losses from hits on the turrets are well illustrated by the following two incidents.

A 38-centimeter shell pierced "Cæsar" turret of the *Derfflinger* and exploded inside. The turret commander lost both legs. Seventy-three of the 78 men composing the turret's crew were killed. Five men, some severely wounded, succeeded in saving themselves from the suffocating flames by climbing through the hole used for the ejection of empty cartridge cases.

This explosion ignited a charge in the turret, the fire from which advanced to the ammunition hoist, where two more charges were ignited, and then passed to the handling room, causing two more charges to catch fire. "The cartridges burned with sheets of suffocating flames, which arose into the heavens far above the turret, but they merely burned and did not explode as the charges of our enemy had done. That was the salvation of the ship. But, in spite of that, the burning of the charges was disastrous in its effect. The awful suffocating flame destroyed everything in its reach. * * *"

"A few moments after this catastrophe a second occurred. A 38-centimeter shell landed on the roof of the turret "Dora," penetrating it, and in this case also exploding inside the turret, creating a new scene of horrors. With the exception of a single man, who was hurled out of the turret through the manhole by the pressure of air resulting from the explosion, the entire turret crew, including the personnel of the ammunition room, in all 80 men, went together to their death. Under the leadership of Gun Captain Arndt, in command of the turret "Dora," the crew had stuck to their guns with heroic courage to the last second. Here again the burning gas ignited the charges not incased in their protective packings, the flames extending even to the magazine located deep down in the ship. Large tongues of flames mixed with yellow masses of smoke shot up toward the heavens from both after turrets like two gruesome funeral torches." (Commander George von Hase, of the German Navy.)

It will be noticed that most of the casualties occurring in turrets are killed; very few are able to survive the effect of an explosion of a penetrating shell which often starts a powder fire.

(4) *Casualties above main decks of capital ships.*—A 12-inch shell bursting 30 yards short of the *Colossus* wounded one man on the bridge and two in the foretop.

There were six instances at Jutland of the radio installation being put out of action from gun fire.

The chart house of the *Derfflinger* was destroyed by a 12-15-inch shell.

Three casualties were caused in the director station of the *Warspite* by a 12-inch shell wrecking the armored tube to the after director.

A 12-inch shell hit an armored gun station of the *Derfflinger*, failed to penetrate, and did no damage to the personnel inside. However, fragments of shell entered through the outlook slits of the forward control station wounding some of the men inside. The explosion of this shell blew open and jammed the heavy armored door of the gun station, which—by a singular coincidence—was later closed by the blast of another shell exploding under the bridge.

A 12-inch shell exploded in the superstructure of the *Warspite* and started a fire which burned out practically all the superstructure.

Fires are serious factors in causing casualties on board capital ships. Of 29 reported fires at Jutland, 14 were caused by burning powder. In six cases, the fire mains were cut. (Frost.)

No masts were seriously damaged at Jutland from gunfire. The splinter-proof armor of the tops proved satisfactory protection for the personnel as only two men were wounded in the tops. However, in the Russo-Japanese War, a hit on the foretop of the *Gromoboi* killed one officer and 12 men.

A projectile hit the signal deck and front smoke stack of the *Hamburg* killing every one on the port side of this deck, and killing or wounding all on the bridge.

The *Oldenburg* was hit by a 4-inch shell from a British destroyer. This shell struck the searchlight platform, killing 11 and wounding 12 on the platform and bridge.

The *Rheinland* was hit on the searchlight platform. This hit, together with another, resulting in 8 killed and 15 wounded.

Suggested Medical Organization on Board Capital Ships in Action

The accompanying organization for the medical department of capital ships in action is taken from the outline contained in the sanitary report of the *Idaho*, for the year 1919, as prepared by Commander P. S. Rossiter, Medical Corps, United States Navy.

Several helpful suggestions pertaining to this topic have been obtained from Capt. J. C. Pryor, Medical Corps, United States Navy, formerly fleet surgeon of the United States Fleet. This authority advocates planning upon as many assistants from other branches of the services as may be used advantageously, thus leaving the medical attendants free for strictly professional duties. Orderly attendants should be assigned each dressing station after battle to clear away the filth and débris. The captain's, wardroom, and junior officers' stewards should be detailed, one to each station, to prepare hot drinks and soups for the wounded. Hot electric plates may be utilized to furnish heat for this purpose.

I. Main Battle Dressing Station (Forward)

1. *Composition:*
   - Senior medical officer.
   - Second medical officer.
   - Chaplain.
   - Hospital corpsmen Nos. 1, 3, 5, 7, 9, 11, and 13.
   - Bandmaster.
   - Stretcher squads Nos. 1, 2, 3, 4, and 5.

2. *Before action:*
   - Senior medical officer inspects equipment and supplies of dressing stations.
   - Second medical officer inspects stretcher squads and equipment.
   - Third medical officer inspects equipment of local aid posts.
   - Hospital corpsmen Nos. 1 and 3 superintend removal of sterilizers, operating tables and instruments and rig additional lights.
   - Hospital corpsmen Nos. 5 and 7 remove patients; procure gas masks; remove additional supplies from storerooms.
   - Hospital corpsmen Nos. 7 and 9 transfer bedding and mattresses from sick bay. Obtain extra blankets from supply officer.
   - Hospital corpsmen 11 and 13 superintend the issue of supplies to local aid posts.
   - Ambulance party distribute litters.
3. *During action:*
   - Senior medical officer stands by for a lull in battle.
   - Chaplain as recorder.
   - Surgical team—
     - Second medical officer.
     - Hospital corpsman No. 1 as surgical assistant.
     - Hospital corpsman No. 3 as anesthetist.
     - Hospital corpsman No. 5, in charge of sterilizer and additional surgical assistant.
     - Hospital corpsman No. 7 assists with sterilizer.
     - Hospital corpsman No. 9 administers narcotics, tags wounded.
     - Hospital corpsmen Nos. 11 and 13, general utility.
     - Bandmaster mans telephone.
4. *After action or during lull:*
   - Senior medical officer makes rapid tour of inspection of compartments where accidents have been reported, and has charge of preparations for postcombat hospital.
   - Surgical team continues dressing of wounded.
   - Hospital corpsman No. 7 superintends the care of the dead.
   - Hospital corpsmen Nos. 11 and 13 establish forward temporary dressing stations for rapid "filtering" out of the slightly wounded from the flow of casualties going below.
   - Bandmaster directs stretcher squads.
   - Stretcher squads make systematic search for wounded.

II. AUXILIARY BATTLE DRESSING STATION (AFT)

1. *Composition:*
   Third medical officer.
   Chief pharmacist's mate.
   Hospital corpsmen Nos. 2, 4, 6, 8, 10, and 12.
   Bandmaster, assistant.
   Stretcher squads Nos. 6, 7, 8, and 9.
2. *Before action:*
   Third medical officer inspects stretcher squads and superintends equipping the station.
   Hospital corpsmen and ambulance party function in same manner as at the main battle dressing station.
3. *During action:*
   Surgical team—similar to outline given under main battle dressing station.
   The chief pharmacist's mate acts as recorder.
4. *After action or during lull:*
   Hospital corpsmen Nos. 11 and 13 establish temporary dressing stations.
   Surgical team continues dressing and care of urgent wounded, if necessary, and, as soon as possible, they prepare a postcombat surgical operating station, or else join the force at the main battle dressing station. When the two after temporary dressing stations cease to function, hospital corpsmen Nos. 11 and 13 fit out a postcombat hospital.

III. THIRD BATTLE DRESSING STATION (MACHINERY SPACES)

1. *Composition:*
   Dental officer.
   Hospital corpsmen Nos. 14, 15, and 16.
   Stretcher squad No. 10.
2. *Before action:*
   Equip station with necessary supplies for treatment of gunshot wounds, and particularly burns.
3. *During action:*
   Removal and treatment of wounded.
4. *After action:*
   Evacuate wounded to surgical operating station or to postcombat hospital (sick bay).

MEDICAL TACTICS OF LIGHT CRUISERS

From a tabulation of the available sanitary reports of light cruisers of the United States Navy, it was found that the principal battle dressing station in all four reporting was established in the

sick bay. Two established the auxiliary station in compartment D–301, one on the main deck aft, and one in C. P. O. quarters.

The structural details of light cruisers will tax the ingenuity of the medical officer in making his plans for locating and transporting the wounded. The high speed of this type of vessel, with abrupt changes in the course, are apt to cause a list which, together with the unusual roll and pitch, will further increase the difficulties of the medical staff in caring for the wounded.

In all, there were 37 light cruisers at Jutland, some of which were under fire for long periods of time, yet only three main battery and five secondary hits in the daylight action were received, except in the case of the *Wiesbaden*, which lay between the lines and was fired at by 25 ships at medium range without being sunk immediately.

Three British light cruisers of the Fourth Light Cruiser Squadron were fired at by German battleships, second line, for eight minutes at a distance of 5,000 to 8,000 yards, yet not one was struck. A large number of German battleships fired for about 50 minutes at four ships of the Second Light Cruiser Squadron without scoring a hit.

In the night phase of Jutland, the light cruisers did not fare so well, as the range was so close that their speed was not a factor in escaping hits.

A British light cruiser was struck by twenty 4.1-inch shells in a 4-minute night battle with German light cruisers, resulting in 47 out of 66 men, composing the crews of the six 6-inch guns amidship, being killed or wounded. Other light cruisers suffered 27, 81, and 36 casualties, respectively.

Very few of the casualties occurred in the fireroom or engine room of light cruisers, the majority happening on upper decks. Large losses took place among the gun crews of this type of vessel from flying shell fragments, many of which could have been prevented by means of splinter-proof gun shields.

Darby (26), of the *Sydney*, relates an interesting case of a German "who appeared to have been the only man on upper deck saved" from the light cruiser *Emden*. This man had been severely wounded in the forearm and, after he had managed to apply a tourniquet, was blown by an explosion overboard into the water. In spite of his severe injury, because of his remarkable constitution and magnificent physique, he succeeded in swimming ashore through the surf. He was later brought aboard the *Sydney* for treatment.

One light cruiser reported that 75 per cent of the personnel on upper decks were either killed or wounded in the brief space of three and one-half minutes, hence "modern naval warfare presup-

poses a high casualty rate and a rapid accumulation of wounded," as stated in the Manual for the Medical Department, United States Navy.

Four 6-inch hits on the *Frankfurt*, one 12-inch hit on the *Pillan*, two 6-inch hits on the *Stettin*, and two 6-inch hits on the *Munchen* caused 21, 26, 25, and 35 casualties, respectively.

Gunfire at Jutland caused practically no damage to the engineer compartments of light cruisers.

It is most interesting to note that, in spite of extensive fires on light cruisers, the number of burned cases compared to the number on capital ships is small. For example, one light cruiser reported two powder fires, the flames reaching masthead; another, a fire on seamen's mess deck; and a third one reported five fires—mostly powder fires—yet the casualties due to burns were only 5, 5, and 13, respectively. The small number of burns is attributed to the open spaces permitting the flames to be dispersed and not confined as they are in the closed spaces on battleships.

The account which follows gives a vivid picture of the difficulties encountered by the medical department of the light cruiser *Southampton*.

" After the action the medical staff were sadly busy. Divided into two parties at opposite ends of the central passage along the main deck, they worked throughout the night under the most appalling conditions. The dressing station was an ill-ventilated bathroom situated just over the boiler rooms, measuring perhaps 8 feet square and hardly 6 feet high. An operating table was in the middle, and the deck as well as the passage outside was a litter of mangled men laid out in rows by the first-aid parties. Add to this a foul atmosphere thick with chloroform, and the painfully depressing sight of numbers of badly wounded men waiting their turn for attention, and the rest may be left to the imagination.

"As each case was passed through the doctor's hands, and his wounds were dressed, he was removed to the wardroom, though this soon became overcrowded, and all officers' cabins were requisitioned. Several cabins were wrecked, and there was a good deal of water about dripping through from the deck above, where fire mains were burst, and water was lying or flowing about. This did not add to the comfort of the wounded, but the holes were soon effectively stopped, and by the morning everyone had been made as comfortable as possible " (65).

The following organization, taken from the Annual Sanitary Report of the U. S. S. *Richmond*, for the year ending December 31, 1924, was prepared by Lieut. T. O. Summers, Medical Corps, United States Navy, and may be considered as a standard for light cruisers:

The battle organization of the Medical Department is based on one main dressing station located in the sick bay and one auxiliary dressing station located in the chief petty officers' quarters aft. Only minor dressings are to be done at the after dressing station, which is in charge of a pharmacist's mate, second class. The organization of each station is as follows:

FORWARD DRESSING STATION

1. *Medical officer.*—In charge; sees that all stations are properly manned; reports "ready" to central station; prepares for minor and major emergency cases.
2. *Chief pharmacist's mate.*—Assists medical officer; gives anesthetics; supervises treatments.
3. *Pharmacist's mate.*—Assists medical officer in all major cases; in charge of operating room.
4. *Pharmacist's mate.*—In charge of litter bearers; dresses minor cases; gives treatments; in charge of identification and disposal of dead.
5. *One litter bearer.*—Assists pharmacist's mate in the identification and disposal of patients.
6. *One litter bearer.*—Man ship's service telephone to receive and transmit all messages; assists in the identification and disposal of dead.
7. *Four litter bearers.*—Man litter and transport patients.

AFTER DRESSING STATION (AUXILIARY)

1. *Pharmacist's mate.*—In charge; sees that the station is manned and reports "ready" over ship's service telephone to central station and forward dressing station; treats minor casualties; directs removal of all major casualties to forward dressing station; in charge of identification and disposal of dead; directs all movements of litter bearers.
2. *Two litter bearers.*—Tend ship's service telephones; receive and transmit messages to pharmacist's mate; assist in the identification and disposal of dead; transport patients.

Litter bearers are furnished from the engineer's force and are instructed in first-aid procedure.

MEDICAL TACTICS OF DESTROYERS

The battle organizations as outlined in the sanitary reports for the year 1923, of first-line destroyers of the United States Navy show the locations of the dressing stations as follows:

Principal battle dressing station.—Wardroom, 83; crews' wash room, 2; chart house, 8; galley, 1; C. P. O. quarters, 1; sick bay, 1; wardroom pantry, 1; top side, amidship, 1; total reporting, 93.

Reserve battle dressing station.—Crews' wash room, 12; after deck house, 3; not reporting, 78.

Twenty-seven of these destroyers reported the use of members of the commissary department as stretcher bearers; two of the destroyers used engine-room personnel; on one vessel, the repair party functioned as ambulance party; a detail of the deck force perform this duty on one; while the remainder of the vessels gave incomplete or no information on this subject (18).

Stephens says that in destroyers the mess deck below the forecastle offers the most suitable and accessible accommodation for the wounded after battle.

The importance of maintaining—even in time of peace—an auxiliary storing space for dressing materials and other first-aid items is illustrated in the case of the destroyer *McFarland*, which was rammed by the battleship *Arkansas*, the collision causing the cutting of the sick bay and the flooding of the medical storeroom with fuel oil. Fortunately the first-aid pouches and boxes which were maintained in different parts of the ship contained the necessary articles for the treatment of those injured in the collision, otherwise the wounded would have suffered for the lack of first-aid equipment and supplies (18).

In studying the battle organization of destroyers as outlined in the sanitary reports, it was found in some instances that the medical dressing station was rigged above, in order to facilitate transshipment of the wounded in case of the sinking of the ship. This idea is apparently worthy of further consideration as prompt removal of the wounded, in an event of this kind, is a most important consideration, especially in vessels of this type which founder so quickly. The *Nestor* and *Nomad* were each sunk in about three minutes after coming under fire of the leading ships of the German battle fleet.

A position of security for a battle dressing station is impossible to find on the destroyer, as there is practically no space available below the water line, hence the "topside" is almost as secure for the wounded as the wardroom or any other position below. However, the effects of climatic conditions in aggravating shock must be considered in collecting the wounded on the upper deck.

Cases of burns are rare on destroyers during action, as already has been stated.

In 17 British destroyers reporting casualties at Jutland, there was one case of burns, and this person suffered from a combination of burns and shell wounds. The absence of burns is rather remarkable in view of the large number of fires aboard this type of ship, as the Germans state that practically every destroyer hit in the night action seemed to have caught fire. No cases of gas poisoning were reported on the British flotillas at Jutland.

On account of the steam pipes being near the water line and exposed to gunfire, scalds are liable to be encountered on board destroyers. There were several reports of steam lines being cut by shells.

Hemorrhage is apt to be more severe on destroyers for reasons stated elsewhere. Hopkins reported some difficulty in checking primary hemorrhage on board one of the British destroyers.

Destroyers, as they are easily handled and have great speed, should be especially equipped for rescue of the crews of sinking vessels. The Germans evidently made use of old torpedo boats for this purpose according to the following account of a survivor of the *Nomad:* "After a short swim in the sea, a life-saving apparatus in the form of a German torpedo boat, so small that we could almost have taken it on our fists, came up and picked us up out of the water. She was a single-funnel craft, with one popgun on the foc'sle, one torpedo tube mounted on rails, and her decks filled with coal" (65).

There were 19 destroyers put out of action at Jutland from the effect of gunfire. Fourteen others were damaged but able to continue in battle. In nine instances the enginerooms, and in seven the firerooms were damaged sufficiently to put the destroyer out of action.

The *Ardent* sank in one-half an hour after coming under gunfire, only 40 men surviving gunfire when the ship sank and these were all drowned except one person.

All destroyers sunk at Jutland were able to fire torpedoes before sinking. As a general rule, one or more guns of the destroyers put out of action were able to fire up to the last moment. (Frost.)

The destroyer leader *Broke*—apparently not content with the reputation of having the largest percentage of casualties of any of the British surviving ships at Jutland—on April 20, 1917, locked with a German destroyer and furnished one of the few examples in modern naval warfare where wounds from hand-to-hand combat were among the casualties. A desperate conflict took place between the crews; cutlasses and bayonets being a part of the *Broke's* equipment, such weapons were used in this fight to repel boarders. While thus engaged, fire from two other German destroyers had reduced the foremost gun crews of this ship from 18 to 6 men.

In connection with a fight on board a warship, attention is invited to article 7 of the Hague Convention of October 18, 1907, which makes provision that under these circumstances the sick bay shall be respected and spared as far as possible.

(*To be continued in the October number*)

BIBLIOGRAPHY

1. Stirling, Y.: Fundamentals of Naval Service, J. B. Lippincott & Co., Philadelphia, 1917.
2. Medical Tactics, The Army Med. Bull. No. 14, Carlisle Barracks, Pa., 1925.
3. Redondo, D. J.: First Aid to the Wounded in Naval Battles, Mil. Surgeon, 17: 291, 1905.
4. Stitt, E. R.: The Medical Department in Battle at Sea, Mil. Surgeon, 57: 341 (Oct.), 1925.
5. Hospital Corps Handbook, United States Navy, page 311, Government Printing Office, Washington, 1923.

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6. Dunbar, A. W.: The Medical Department in Warfare, U. S. Nav. M. Bull. 7:555 (Oct.), 1923.
7. Farenholt, A.: The Medical Department at General Quarters and Preparations for Battle, U. S. Nav. M. Bull. 8:421 (July), 1914.
8. Stephens, H. E. R.: Surgery in a Fighting Ship, Keen's Surgery, 6:249. W. B. Saunders Co., Philadelphia, 1921.
9. Darrieus, G. and Daveluy, R.: War on the Sea and Extracts from the Genius of Naval Warfare. Translated by Philip Alger, Annapolis, Md., 1920.
10. Simons, M. H.: Sanitation—Requirements for Navy Ashore and Afloat, Mil. Surgeon, 27:107, 1908.
11. Shippen, E.: Naval Battles, Ancient and Modern, J. C. McCurdy & Co., Philadelphia, 1883.
12. The Surgical and Medical History of the Naval War between Japan and China during 1904–5. Translated by S. Suzuki under the direction of Baron Saneyoshi, Toyo Printing Co. (Ltd.), Tokyo, 1911.
13. Reports from the Office of Naval Intelligence, U. S. Navy.
14. Horner, T.: The Navy Medical Corps, J. A. M. A. 24:347, 1895.
15. Reports of the Surgeon General, U. S. Navy. (Various Annual Reports.)
16. Muir, J. R.: Hints for the Use of Medical Officers in Action, J. Roy. Nav. Med. Serv. 4:405 (Oct.), 1916.
17. Maclean, A., and Stephens, H. E. R.: Surgical Experience in the Battle of Jutland, J. Roy. Nav. Med. Serv. 2:421 (Oct.), 1916.
18. Sanitary reports from various ships of the U. S. Navy.
19. Rixey, P. M.: Naval Surgery. Chapter LXVII, page 1018 of Volume IV of Keen's Surgery, W. B. Saunders Co., Philadelphia, 1908.
20. Bell, W. H.: Naval Surgery, Chapter CXL, page 748 of Volume VI of Keen's Surgery. W. B. Saunders Co., Philadelphia, 1913.
21. Admiralty Orders—1946—The Treatment of Wounded on Board H. M. Ships During and After Action. (M. D. 8123/15–13, 11, 1915.)
22. Muir, J. R.: The North Sea Action of January 24, J. Roy. Nav. Med. Serv. 1:155 (April), 1915.
23. Corbett, J. S.: Naval Operations, Longmans, Green & Co., London, 1920.
24. The Literary Digest History of the World War, Volume 10, New York, 1920.
25. Hill, R.: A Retrospect of Naval Medical Conditions, J. Roy. Nav. Med. Serv. 6:1 (January), 1920.
26. Darby, L.: Report on the Wounded in Action Between the *Sydney* and the *Emden*, J. Roy. Nav. Med. Serv., 1, 227 (July), 1915.
27. Fergusson, G. D. G.: "Extracts." J. Roy. Nav. Med. Serv., 3:128 (Jan.), 1917.
28. Richards, T. W.: Loss of Life by Drowning in Naval Warfare, U. S. Nav. M. Bull. 6:166 (Jan.), 1912.
29. Official History (Naval and Military) of the Russo-Japanese War, Vol. 1, Appendix S., pp. 522–524. London, 1910.
30. Colborne, W. J.: Arrangements for Dealing with the Wounded on Board Ship, J. Roy. Nav. Med. Serv. 1:76 (Jan.), 1915.
31. Bean, A. C.: Action Stations in Time of War, J. Roy Nav. Med. Serv. 1:80 (Jan.), 1915.
32. Marsh, A. B.: Medical Account of Action in the Adriatic, May 15, 1917, J. Roy. Nav. Med. Serv. 4:376 (Oct), 1918.
33. McCutcheon, J.: Medical Arrangements in H. M. S., *Vindictive* at Zeebrugge on April 22–23, 1918, J. Roy. Nav. Med. Serv. 1:5 (Jan.), 1915.

34. Stokes, C. F.: Some Features of the Immediate Treatment and Transport of the Wounded in Naval Warfare, Mil. Surgeon 15:481, 1904.
35. Bunton, C. L. W.: Dressing Stations in Large Ships, J. Roy. Nav. Med. Serv. 3:149 (Apr.), 1917.
36. Carpenter, D. N.: Duties of the Medical Department at "General Quarters, Mil. Surgeon 10:584, 1901.
37. The Medical Service of the Royal Navy. The Times History of the War, Volume IX, Chapter 144, page 241, London, 1916.
38. Gittings, F. C. B.: First-aid Lockers, J. Roy. Nav. Med. Serv. 4:326 (July), 1918.
39. MacLeod, G. E.: A Galvanized-Iron Cupboard for First-Aid Dressings as a Permanent Fitting in Turrets and Casemates, J. Roy. Nav. Med. Serv. 1:351 (July), 1915.
40. Holmes, J. McA.: The Treatment and Disposal of the Wounded in a Light Cruiser During the Battle of Jutland, J. Roy. Nav. Med. Serv. 2:426 (Oct.), 1916.
41. Austen, T.: "Extracts," J. Roy. Nav. Med. Serv. 4:106 (Jan.), 1918.
42. Pugh, W. S.: Equipment of Battle Dressing-Station Storerooms, U. S. Nav. M. Bull. 13:786 (Oct.), 1919.
43. Spear, R.: Report on the Russian Medical and Sanitary Features of the Russo-Japanese War, Government Printing Office, Washington, D. C., 1906.
44. Braisted, W. C.: Report on the Japanese Naval Medical and Sanitary Features of the Russo-Japanese War, Government Printing Office, Washington, D. C., 1906.
45. Barthelemy, P.: First-aid Stations and Transportation of the Wounded in Naval Warfare, Translated by S. C. Evans in the U. S. Nav. M. Bull. 9:454 (July), 1915.
46. Manual of Instruction for the Royal Naval Sick Berth Staff, 1915, London.
47. Bogert, E. S.: Transportation of Patients, Supplement, U. S. Nav. M. Bull. p. 25 (Apr.), 1919.
48. Boyden, P. H.: Note on a New Ambulance Sling, J. Roy. Nav. Med. Serv. 2:105 (Jan.), 1916.
49. Verry, G. T.: Transport of Wounded, J. Roy. Nav. Med. Serv. 4:98 (Jan.), 1918.
50. Urie, J. F.: Battle Organization for the Medical Department on Shipboard, U. S. Nav. M. Bull. 2:51 (July), 1908.
51. Stephens, H. E. R.: Immediate Surgery in Fighting Ships, J. Roy. Nav. Med. Serv. 7:139 (Apr.), 1921.
52. Bunton, C. L. W.: Wounded Treated at Royal Naval Hospital, Shotley. J. Roy. Nav. Med. Serv. 1:15 (Jan.), 1915.
53. Turnbull, W.: The Naval Surgeon, London, 1806.
54. Penfold, E. A.: A Battleship in Action, J. Roy. Nav. Med. Serv. 3:44 (Jan.), 1917.
55. Hingston, W. P.: "Extracts." J. Roy. Nav. Med. Serv. 4:432 (Oct.), 1918.
56. MacKenzie, K. A. I.: Some Observations in a Recent Action, 4:205 (Apr.), 1918.
57. Stokes, C. F., Naval Surgery, American Practice of Surgery, 1910.
58. Hewitt, A. J.: Report on the Casualties in Action Between the "Pegasus" and the "Konigsberg," J. Roy. Nav. Med. Serv. 1:143 (Apr.), 1915.
59. Borrett, G. G.: "Extracts." J. Roy. Nav. Med. Serv. 3:361 (July), 1917.

60. Bell, W. H.: Medical Department, Keen's Surgery, 6:167, Philadelphia, 1921.
61. Zur Verth, M.: Das Lazarettschiff. Jena, Verlag. von Gustav Fischer, 1920.
62. Ruddock, J. C.: Sanitary Aspects of the Grounding of the U. S. S. *Northern Pacific*, U. S. Nav. M. Bull. 14:185 (Jan.), 1920.
63. Borrett, G. G.: "Extracts." J. Roy. Nav. Med. Serv. 3:363 (July), 1917.
64. Stitt, E. R.: The Handling of Wounded on Shipboard During Action, Mil. Surgeon 5:324, 1895.
65. Fawcett, H. W. and Hooper, G. W. W.: The Fighting at Jutland, London, 1921.
66. Fiske, C. N.: What is the Best Organization of the Medical Department of the Fleet for Battle, Mil. Surgeon, 33:240, 1913.
67. Carpenter, D. N.: The Organization of the Medical Department of the Division for Battle, Mil. Surgeon, 33:330, 1913.
68. Oman, C. M.: The Preparation of Wounded for Transfer and Transport After Battle, Mil. Surgeon, 33:335, 1913.
69. Cather, D. C.: An Organization for the Transportation of Wounded After Battle in a Battleship, Mil. Surgeon, 33:344, 1913.
70. Blackwell, E. M.: Transportation of Wounded from Ship of War to the Sanitary Base, Mil. Surgeon, 33:348, 1913.

In addition to the references listed above, the following contain information on this subject:

Awguestowsky, N. I.: Aid to the Wounded in Modern Naval Warfare, Mil. Surgeon, 32:490, 1913; also *ibid*, page 573.

Beyer, H. G.: A Review of the Subject of "Organization of the Medical Department (Naval) for Battle," U. S. Nav. M. Bull. 2:46 (Oct.), 1908.

Beyer, H. G.: The Care and Removal of Sick and Wounded on Shipboard During and After Action, Mil. Surgeon, 26:15, 1910.

Blackwell, E. M.: An Apparatus for Hoisting Patients Aboard the Hospital Ship *Solace*, U. S. Nav. M. Bull. 5:467 (Oct.), 1911.

Caronel, D.: Secours aux blesses, pendant le combat, Arch. de Med. Navale, 3:486 (Oct.), 1917.

Dalton, T. J. A.: Immediate Surgery of War Wounds as Practiced on Hospital Ships. J. Roy. Nav. Med. Serv. 7:217 (July), 1921.

Editorial: Medical Department Organization for Battle, U. S. Nav. M. Bull., 1:14 (Apr.), 1907.

Farenholt, A.: Preparations of the Naval Medical Department for Battle, Mil. Surgeon, 38:281, 1916.

Fisher, A. R.: Notes on Immediate Surgery of Naval Wounded on Hospital Yachts and Small Craft, J. Roy. Nav. Med. Serv. 7:224 (Oct.), 1921.

Gravatt, C. U.: Transportation of Wounded on Shipboard, Mil. Surgeon, 19:86, 1900.

Hingston, W. P.: "Extracts," J. Roy. Nav. Med. Serv. 4:432 (Oct.), 1918.

McCullough, F. E.: Logistics of the Medical Department of the Navy for Distant Operations of the Fleet, Mil. Surgeon, 45:502, 1915.

Narrative of the Battle of Jutland, H. M. Stationery Office, London, 1924.

Old, E. H. H.: Removal of Wounded Men from the U. S. S. *Northern Pacific* to the U. S. S. *Solace*, January 3 and 4, 1919, U. S. Nav. M. Bull., 13:349 (Apr.), 1919.

Pasquale, A.: The Organization of the Naval Sanitary Service, Translation by H. G. Beyer—Mil. Surgeon, 25:336, 1909; also same volume, page 474.

Pleadwell, F. L.: The Tenth Convention of the Second Hague Conference of 1907. U. S. Nav. M. Bull. 5:409 (July), 1911.

Redondo, D. J.: Dressing Stations on Warships, Translated by C. N. Barney, Mil. Surgeon, 13: 389, 1903.
Russell, C. H.: Aid to the Wounded on Shipboard, Mil. Surgeon, 5: 305, 1895.
Smith, R. K.: Care of Wounded on Board a Modern Ship of War, Mil. Surgeon, 19: 90, 1900.
The Surgical and Medical History of the Naval War Between Japan and Russia During 1904–5, Tokyo, 1911.
Suzuki, S.: Experiences in the Russo-Japanese War, Mil. Surgeon, 17: 420, 1905.
Tomatsuri, B.; Surgeries on Board Warships for Use During Action, Mil. Surg. 15: 541, 1909.
Waddy, S. H.: Twelve Months in a T. B. D., J. Roy. Nav. Med. Serv., 4: 313 (July), 1918.
Wakeley, C. P. G.: The Treatment of War Burns, *ibid* 3: 156 (Apr.), 1917.
Wise, J. C.: First Aid in Naval Warfare, Mil. Surgeon, 16: 153, 1905.
Wise, J. C.: Should Protected Hospitals Be Built in Ships of War? U. S. Nav. M. Bull, 1: 102 (July), 1907.
Wise, J. C.: Ship Organization in Action, Mil. Surgeons, 26: 43, 1910.
Zur Verth, M.: Hospital Ship, Mil. Surgeon, 30: 429, 1912.

THE MEDICAL NEEDS OF THE REPUBLIC OF HAITI AT THE PRESENT TIME [1]

By C. S. Butler, Commander, Medical Corps, United States Navy

The Agricultural Department of the Haitian Government and the Government's Public Health Service are in many ways working for the same ends. The one is striving to make the soil produce more food, while the other has as one of its objects the physical betterment of the Haitian people so that they may do more work. It is therefore proper that these two Government departments should occasionally take stock of the machinery at hand for attaining the desired ends. This paper will attempt to point out some of the objects which the Public Health Service is striving to attain and some of the defects in its machinery for doing the work.

In order to understand the Republic's present-day problems in medicine it will be necessary to recall a few facts in history. There are those who think that Christopher Columbus made a horrible mistake when he discovered Haiti, because, since that memorable 6th of December, 1492, when he came ashore at Môle St. Nicolas, Haiti and her peoples have undergone much suffering and endured many injustices at the hands of the magnanimous whites. Gold getting or commercial advancement have activated most of the white men's ultruism. So it is little wonder that, after the island's 400 and more years of intensive exploitation, the present-day Haitian when threatened with more altruism should immediately look for the "*blanc* in the woodpile." We white people killed off most of the Indians so that within 60 years after the discovery they were, for all practical purposes, exterminated. As early as 1512, seeing that the poor Caribs could no longer serve our greed effectively,

[1] Read at a meeting of the staff of the Department of Agriculture of the Haitian Government at Port-au-Prince on Nov. 23, 1925.

we whites began to substitute African slaves. Each European colonist was allowed 12 (1) of these and the traffic increased to such an extent that by 1790 there were 509,642 of them in the French colony alone. These slaves had been brought from every section of equatorial Africa and at the time Haiti gained her independence they outnumbered the whites by upwards of 16 to 1.

Moreau de Saint-Méry (2) in his remarkable account of the slaves, their characteristics, and the sources whence they were drawn, lists African towns and cities all the way from the mouth of the Senegal at 17° north latitude on the West African coast clear around the Cape of Good Hope and up to Mozambique at 10° south latitude on the east coast. Madagascar also furnished slaves to the West Indies. Not alone the coast line, but the interior of the continent also furnished them. To us who are familiar with the deadly diseases which are found in this immense area of Africa, the wonder is that the West Indies and the two Americas came out of the slave trade as well as they did in the matter of disease importations.

It is reasonable to think that during 292 years of slave trade between 1512 and 1804 every type of disease that the Continent of Africa might boast of had been brought to Haiti. It is sound medicine also to reason that all African diseases except those requiring vectors not present in Haiti have prospered here. This statement also applies to African types of religious worship (Voodooism). In 1804, accordingly, the Nosology of Haiti, had there been such, would have included all of the diseases that 312 years of European intercourse could contribute, together with what Africa could add during 292 years of the slave trade. These two are, of course, to be supplemented by such strictly American contributions as the Caribs could make before they were exterminated.

If I may digress for a moment, I wish to draw attention to the absurdity of accusing Haiti of having added syphilis to the world's list of diseases. Certain American authors (3), following the teaching of Iwan Block (4) and Rodrigo de Isla, have given circumstantial accounts of how Columbus's crew carried back to Europe this disease which Europe, according to the authors, had not hitherto known. One of the Pinzon brothers is said to have been so unfortunate as to acquire syphilis in Hispañola; and according to these accounts its recognition would seem so easy that one could almost picture a physician waiting on the dock at Barcelona to take this particular Pinzon off the ship and make a diagnosis upon him of this hitherto unknown but always confusing disease. Poor innocent Europe with her untold centuries of venery had to come to little barbarous Haiti in order to get "syphilized"! I have not a doubt that one or both of the Pinzon brothers had syphilis, and they may have acquired it here in Haiti; but the records are too good in

establishing the existence of the disease "morbus gallicus" for Europe at a time before Columbus ever set out upon his perilous voyage to justify any fair-minded medical man in concluding that Europe got her syphilis from America. Furthermore, there is no more to wonder at in the fact that the renaissance in medicine during the latter half of the fifteenth century waked physicians to the fact that they had been living with diseases they had never before recognized than there is in the fact that they had been living on an earth which was round but which, up to then, they had thought was flat. By such a line of reasoning many other human diseases could be "traced" to America.

No physician who understands the epidemiology of leprosy can read the account of that disease in Europe between the ninth and fifteenth centuries as set forth in that storehouse of medical learning written by the talented physician August Hirsch (6) and fail to see that what they were dealing with in the thirteenth century's 19,000 leper houses was largely syphilis and not all leprosy by any means. Here was a monumental mistake in diagnosis, a mistake made only too frequently even at the present time. A few prehistoric North American Indian bones showing syphilitic osteitis should not close our minds to all the epidemiological and other evidence of pre-Columbian European syphilis.

The fact that the three venereal diseases were not separated as to their etiology until well into the nineteenth century stultifies any attempt to prove that one of them had its origin in America and points to the bootlessness of trying to use any except very recent knowledge to prove the diagnosis or establish the origin of any of the human diseases. We know from the writings of Sydenham (5) that treponematosis (syphilis or yaws) came in the slave ships from Africa. This is from actual medical observation connected with the slave trade. These conditions were then the chief cause of damage to the slave trade, just as now they are economically the most important conditions we have to deal with here in Haiti.

In connection with this difficulty of determining the origin of any human disease I wish to quote a couple of paragraphs from Hirsch's classical article on yellow fever. If the medical men in this gathering were asked what human disease has the best right to claim a strictly American origin, I doubt not that they would immediately answer, "yellow fever." In speaking of the probabilities as to whether tropical America or the West Coast of Africa was the home of this disease, Hirsch (6) says:

The earliest history of yellow fever in the former of these two regions (America) is enveloped in an obscurity which we can not enlighten. In particular, there is no way of getting an answer to the question whether the disease was prevalent there—if so, to what extent—before the arrival of European colonists, or the question when and under what circumstances it

I hasten to say that not all of this public health load has been moved by any means. Much of it is untouched. The yellow fever mosquito for instance still breeds in much of her pristine glory. But since 1915 a "disinterested altruism," to use a hibernianism, on the part of the United States Government has been met by an honest effort on the part of the Haitian Government "To get things right" in so far as Haiti's limited means will permit. We will list the improvements which have been effected in the Public Health Service, year by year since 1915. In that year a general cleaning up campaign was undertaken and refuse and filth were removed from streets, public places, and private properties.

In 1916 the Government Hospitals were put in charge of United States naval medical officers and a medical service was actually started. During this year marked progress was made at the Haitian General Hospital in Port au Prince, three wards and a main kitchen being built.

During 1917 a sanitary engineer was appointed in accordance with the Treaty of September 16, 1915. At the end of 1917 the sanitary engineer had at his disposal seven assistants and was now ready to take over from the forces of occupation all matters having a bearing on public health work, including sanitation, quarantine, and hospitals.

In 1918 the Republic was divided into three districts, the Central, Northern, and Southern, with headquarters at Port au Prince, Cape Haitien, and Aux Cayes, respectively. As funds became available, improved methods of handling the sanitary work were inaugurated in many of the larger cities. The French sisters showed a true spirit of cooperation. In July of this year two nurses of the United States Navy Nurse Corps arrived and assumed supervision of a training school for native nurses at the Haitian General Hospital in Port au Prince. This school was opened in October, 1918, with 24 pupils and graduated its first class of 14 in 1921. Since that time this training school, now directed by American Red Cross nurses, has proved one of the best assets of the Government's medical organization.

The year 1919 was productive of much benefit to the Republic and to the Public Health Service. During this period it was possible to increase the personnel by six officers and two nurses, to reorganize and place all districts under the supervision of public health officers. The country was divided into nine districts, the most important ports acting as headquarters for the various districts, namely: Port au Prince, Cape Haitien, Port au Paix, Gonaives, Saint-Marc, Petit-Goave, Jeremie, Aus Cayes, and Jacmel. United States naval medical officers were in charge of the public

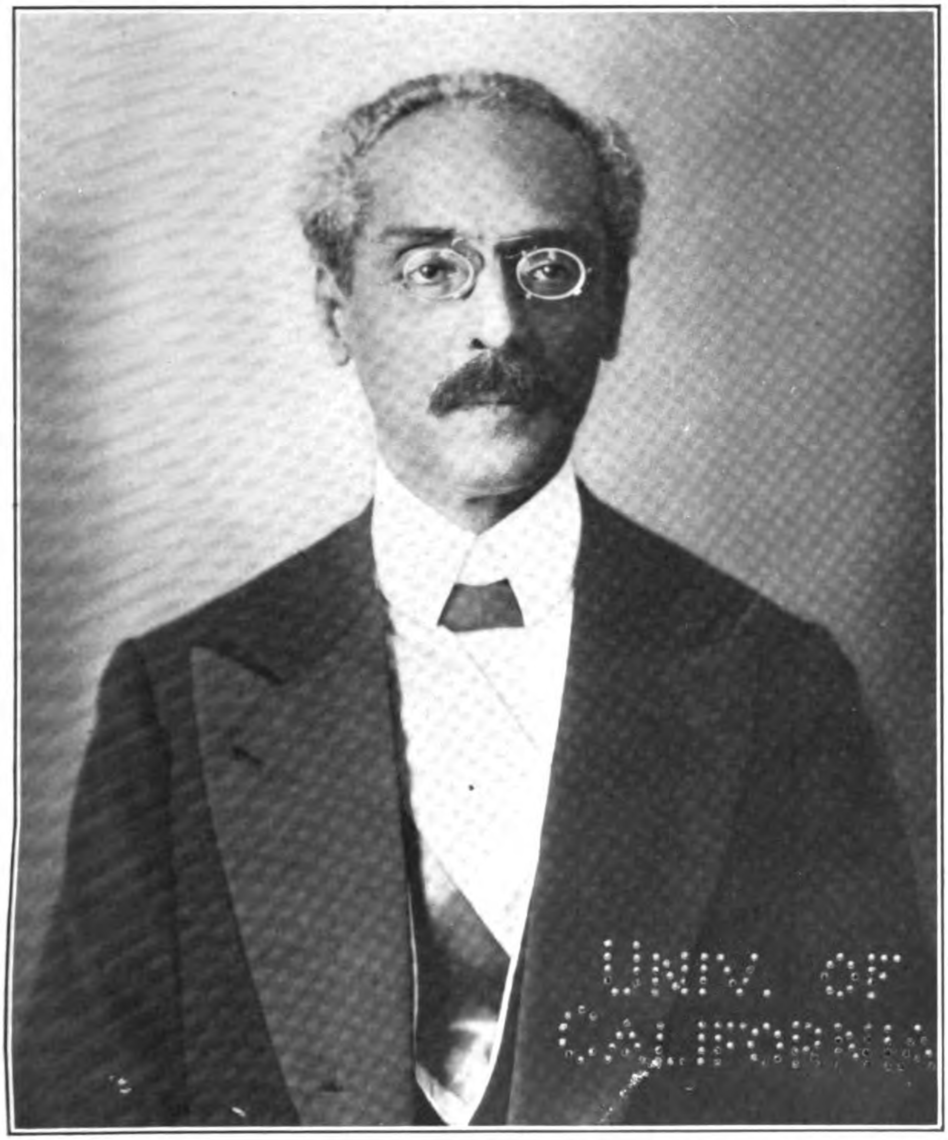

FIG. 1.—HIS EXCELLENCY MR. LOUIS BORNO, PRESIDENT OF THE REPUBLIC OF HAITI. THE PRESIDENT IS A HIGHLY EDUCATED AND TALENTED MAN WITH A POETICAL TURN OF MIND. A LAWYER BY PROFESSION, MR. BORNO IS A FINISHED AND CONVINCING ORATOR. HE IS GIVING HIS PEOPLE A VERY CREDITABLE ADMINISTRATION

FIG. 2.—THE AMERICAN HIGH COMMISSIONER TO HAITI, GEN. JOHN H. RUSSELL, UNITED STATES MARINE CORPS, WHOSE WIDE KNOWLEDGE OF HAITI AND HER PEOPLE IS BEING APPLIED TO A SOLUTION OF THE REPUBLIC'S DIFFICULT PROBLEMS WITH A SPIRIT OF REAL ALTRUISM

health districts of Port au Prince, Cape Haitien, Aux Cayes, and Jacmel, the other districts being in charge of pharmacists.

A law establishing the Public Health Service was finally enacted February 26, 1919, and based on this law there was published on April 12, 1919, the Sanitary Rules and Regulations, and on December 17, 1919, the Quarantine Regulations. Public latrines were built in the larger towns and the number of private latrines was very greatly increased. Hospitals were taken over by the service throughout the Republic.

During 1920 smallpox appeared in Haiti and spread over nearly the entire island. Tremendous efforts were made to check the epidemic by means of a generalized vaccination. Ever since the occupation the medical officers of the Navy had been fighting for vaccination, but it was not until the epidemic of smallpox occurred that proper response was given. It is estimated that between 850,000 and 900,000 people were vaccinated. It is believed that about 60 per cent of the people contracted smallpox, chiefly those that were vaccinated escaping. During 1920 a compulsory vaccination law was enacted. A central storehouse was built at Port au Prince and a garage opened to take care of trucks used by Service d'Hygiène.

During the year 1921 a new modern operating room was built at the Haitian General Hospital, Port au Prince, and a laboratory was also equipped at the same institution.

In 1922 a system of free dispensary service was inaugurated by the establishment of rural dispensaries situated at Grande Riviére du Nord, Mirebalais, Hinche, and Lascahobas. The one at Lascahobas was discontinued upon the withdrawal of a large force of men employed in building new roads in that vicinity. These dispensaries were established to bring medical assistance to a large territory practically never visited by a physician.

During 1922 a nurses' home was completed at the Haitian General Hospital, Port au Prince, and one of the old wards was replaced by a new one. A new morgue was also completed, and at Cape Haitien a ward for the isolation and treatment of tuberculosis patients was completed. Port de Paix at that time had only a small building with a capacity of 15 beds, which was rented for hospital purposes. At Gonaives during 1922 a new ward for treatment of women patients was finished.

In 1923 a new ward for the care of private patients was completed and placed in commission at Port au Prince and during this same year X-ray work was begun there. A general poorhouse was opened at Port au Prince and a new hospital was finished at Jeremie. During this year a beginning was made in the important matter of a rural clinical service, especially in the districts of Cape Haitien and Jacmel. Numerous sanitary improvements were begun throughout

the Republic, such as drainage and filling of swampy tracts, building of latrines, care of markets and slaughterhouses. The sanitary inspection service has improved with the increasing experience of the sanitary inspectors.

During 1922 and 1923 the funds available for the public health service were increased, and during 1924, its personnel was also increased, making it possible to inaugurate various changes in organization with subsequent enlargement of its scope of activities. This has enabled the sanitary engineer to place at least one United States naval medical officer and a chief pharmacist's mate in each of the 10 public health districts now organized. By means of this personnel an intelligent supervision can be given to sanitary measures in all the principal cities and towns and in some of the larger villages. An up-to-date hospital service can be given in all of the larger cities. A rural clinical service has been developed throughout the Republic giving medical attendance in over 100 places once to four times a month.

During June, 1924, the Haiti survey of the Rockefeller Foundation began work here under the intelligent direction of Dr. George C. Payne. The director of this survey has cooperated with the Sanitary Engineer in every possible way and it is a pleasure to me to take this opportunity of acknowledging the debt which Service d'Hygiène owes to him and his staff and to those who made it possible for Haiti to avail herself of their valuable service. This survey has helped us to a better understanding of the magnitude of our public health problems, and helped us to break through the armor of superstition and voodooism which affects all too many communities in Haiti. Having broken through this armor the survey has helped us to get facts about disease, and to cure disease to the great discomfiture of the voodoo doctors. Doctor Payne has helped Service d'Hygiène in so many ways and with so much cheerfulness withal, that we shall be very sorry to see him go.

From a sanitary standpoint it may be stated that the hygienic conscience of the people has been awakened. There exists in many places a friendly rivalry between communities as to which is the cleaner town. A more or less extensive survey of mosquito breeding has been made over most of the Republic, showing the tremendous task that confronts the Public Health Service in its efforts to reduce the incidence of mosquito-borne diseases. In the larger cities marked progress has been made in eradicating mosquitoes. In Port au Prince, the entire lower section, which in 1915 was a continuous swampy tract, has now been filled and drained. Similar swampy areas have been removed in Cape Haitien, Jacmel, Petit Goave, and elsewhere.

In the larger communes the use of the privy has been made nearly universal. In the rural districts, however, this sanitary necessity is still practically unknown. The cleanliness of streets throughout the cities of the Republic is an outstanding feature. The larger cities are supplied with trucks for the street cleaning service, the refuse being used to fill in swampy tracts. Gangs of laborers are kept busy cleaning ditches and drains in order to prevent stagnation of water with subsequent mosquito breeding.

A general system of school inspection has been introduced, in order to check up vaccination and, in malarious districts, to determine the extent of malaria. In some of the worst sections a splenic index of from 50 to 80 has been found to exist. It is remarkable how the operation of these schools improves under the administration of quinine to the pupils.

With regard to the actual medical attendance afforded the people of Haiti to-day, there has been a tremendous development during the past 10 years. In 1915 there were in some of the larger cities a few poorhouses operating under the name of hospitals. To-day Port au Prince, Cape Haitien, Hinche, and Aux Cayes can point with pride to hospitals with bed capacities of from 100 to 400. These hospitals are equipped with modern appliances and facilities, including X-ray machines, laboratories, operating rooms, and dispensaries. Towns such as Gonaives, Jeremie, and Jacmel, have smaller but nevertheless modern institutions. Money will be soon available to replace the old structures of Saint Marc and Petit Goave with better buildings. Port de Paix is building a new hospital at the present moment and in Aux Cayes new additions are rapidly maturing. Formerly the populace dreaded the idea of going to a hospital. This prejudice is now, in large measure, overcome.

A building program is under way to supply the smaller communes along the coast and in the interior with dispensaries where proper treatment may be given either by a local physician or by a visiting public health officer.

In a country where the morbidity is so tremendous as in Haiti; where so many people suffer from acute and chronic diseases; where syphilis and yaws probably affect 70 per cent of the population; where, in the worst districts, nearly 100 per cent of the population is suffering from malaria; where diseases transmitted through night-soil, such as dysenteries, typhoid fever, and hookworm disease are so common; in such a country, the importance of a well-developed rural clinical service is paramount. In order to take care of this mass of disease, 20 rural standard dispensaries are nearing completion. In addition, 100 places are visited several times a month by medical officers. Thus over 35,000 people are seen each month. The educational value of this massive treatment, aside from its purely

medical importance, is great. The country districts where voodooism was formerly rampant are now being invaded by modern ideas regarding sickness and health.

Negotiations are under way for acquiring sites for a quarantine station, asylum for insane, hospital for lepers, and homes for indigents and orphans, all institutions sorely needed in Haiti.

One of the important features of the development of the Haitian Public Health Service is the education of the younger members of the native medical profession. Year by year more native physicians are employed by the public health service, and to the best of their ability they absorb the spirit pervading the service. But these men unfortunately haven't much to build upon. They are all graduates of the National School of Medicine of Haiti, which institution has had almost no chance to develop. At present this school is in process of renovation. Negotiations are under way for compelling the medical students to take advantage of the clinical and laboratory facilities offered by the Haitian General Hospital, whereby the students will become familiar with the practical work of their honorable profession. In the near future it is hoped that a complete reorganization may be effected in this school, giving the Haitian medical men an opportunity to acquire the necessary ability to take care of their big problems in disease.

In the order of their importance to the Republic, I would list the medical needs of Haiti as follows:

1. A good medical school, with French-speaking faculty, capable of graduating from 10 to 15 Haitian physicians per year and giving them a good understanding of modern medicine, surgery, and sanitation.

2. A public health laboratory in Port au Prince capable of doing every type of public health laboratory work.

3. The extension of the several features noted in the body of this paper until they are adequate to the needs of the people in sanitation, hospital service, rural dispensary service, and maritime quarantine.

REFERENCES

(1) The Encyclopædia Britannica, 11th Ed. 25:222.

(2) Moreau de Saint Méry (M. L. E.): Description topographique, physique, civile, politique et historique de la Partie Française de Saint Domingue. Avec des observations générales sur la population sur le caractère et les moeurs de ses divers habitants; sur son climat, sa culture, ses productions, son administration, etc. Accompagnées des détails les plus propres à faire connaitre l'état de cette Colonie à l'époque du 18 Octobre, 1789. (2 vols., Philadelphia, 1797.)

(Topographical, physical, civil, political, and historical description of the French part of Santo Domingo. With some general observations

upon the population, the character and customs of its divers peoples; upon its climate, culture, products, administration, etc. Accompanied by appropriate details to show the condition of this colony up to the 18th of October, 1789.)

(3) Pusey, W. A.: The beginning of syphilis. J. A. M. A., 64:1961: (June 12, 1915.)

(4) A System of Syphilis, by Various Authors, edited by Power and Murphy. Article by Iwan Block on the History of Syphilis.

(5) Sydenham, Thomas (1624–1689), Opera Medica. The Sydenham Society, London, 1850, 2:33.

(6) Handbook of Geographical and Historical Pathology, by Dr. August Hirsch. From the 2d German edition. London, The new Sydenham Society.

(7) St. John, Sir Spencer: Haiti or the Black Republic, 2d Ed. Scribner & Welford, N. Y., 1889.

(8) Froude, James Anthony: The English in the West Indies 1888.

MERCUROCHROME-220 SOLUBLE, FOREIGN PROTEIN, AND SUGAR IN THE TREATMENT OF 200 CASES OF GONORRHEAL URETHRITIS AND COMPLICATIONS, WITH ANIMAL EXPERIMENTATION[1]

By J. E. Potter, Lieutenant Commander, Medical Corps, United States Navy, and Francis H. Redewill, M. D., San Francisco

Eight years ago Hugh H. Young and his associates began the study of over 260 compounds, using dyes as the basis for therapeutic agents, and discovered mercurochrome-220 soluble to be a germicide of great value, with great penetrating power, and relatively non-toxic and nonirritating. They first introduced this drug as a local germicide for the genito-urinary tract (1) and later advocated its use for intravenous medication (2) in the treatment of many types of infections. Since then there has been presented to the medical world very extensive literature on the subject. Two recent articles by these workers of the Brady Urological Institute (3) (4), in which they quote the reports of over 80 doctors throughout the world, demonstrate in a remarkable way the large variety of infections and infectious diseases in which mercurochrome was a deciding factor and a beneficial therapeutic agent.

In our last publication (5), in which we reported over 500 cases, we pointed out that initial maximum doses were interdicted except in extreme cases; that there was a wide variance in the reaction of different individuals; and that, while a certain number were not affected even by continued treatment, a few cases manifested hypersensibility for mercurochrome. Also, by experimentation, we showed that expressed prostatic and seminal fluid of cases treated

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[1] From Department of Urology of the University of California Medical School and the Hooper Foundation for Medical Research. Read before the urological section of the San Francisco County Medical Society, Sept. 29, 1925.

with mercurochrome demonstrated decided bacteriostatic action; that hypersensitive cases will excrete a proportionately greater amount in the saliva and gastro-intestinal fluids than via the kidneys; and that by the use of the diphenylcarbazide test for mercury in the seminal fluid and the mercurochrome kidney function test it is possible, with the first mercurochrome intravenous injection, to detect patients that are not suitable for the continuous use of the drug.

Having used our diphenylcarbazide and mercurochrome kidney function tests on hundreds of clinical cases and demonstrated experimentally the wide variance in the excretion and reaction of different individuals, we were induced, nearly a year ago, following the published reports of Kyrle (6) and Scherber (7), as well as the late complete work of Petersen (8), to give intramuscular injections of foreign protein and sugar in connection with the intravenous use of mercurochrome. These investigators pointed out that when one combines a nonspecific agent, such as the foreign protein in milk, with an etiotropic drug or specific agent like mercury in syphilis, quinine in malaria, and salicylates in certain forms of arthritis, the former medication activates the latter specific agent and so causes it to be more potent, resulting in the more rapid clearing up of symptoms and, in many cases, obtaining striking therapeutic results. Kyrle and Sherber, for example, used milk with mercury in the treatment of syphilis, milk and salicylates in the treatment of arthritis, milk and luminal in the treatment of epilepsy, as well as tuberculin, another foreign protein, and salvarsan in the treatment of lupus. Our older method of treating syphilis with alternating courses of mercury and iodides, used as we know for many decades, made use of, according to Petersen, this form of specific and nonspecific medication in which the nonspecific effect of the iodides is not marked. The effect is to be sought, rather, in the action of the iodides in facilitating the diffusion of and activating the mercury. Just as Kyrle and Scherber have reported excellent results in their various diabasic treatments, so we can report many striking results with the combination of mercurochrome and milk injections, for here, we are not only dealing with a strong nonspecific protein, milk, which activates generally the cells of the body and, according to many investigators, changes their permeability, increases their metabolism, and stimulates the leucocytes and enzymes to greater activity, but we have also an excellent hematogenous remedy, mercurochrome, that has marked bactericidal power with low toxicity and great permeability. In the 200 cases reported below as well as in the animal experimentation, we believe the results obtained will prove that the milk injections intramuscularly activate the intravenously injected mercurochrome.

Brief History of Nonspecific Therapy

It was firmly inculcated for 30 years by medical and laboratory teachings that the resistance of the body to disease depended on specific biological reactions. V. Behring introduced the brilliant era of specificity in therapeutics (9) and the discovery, by Ehrlich, of the specific spirocheticide in the field of chemotherapy brought to a climax those years of success of medical advance made on the idea of strictest specificity. Rumpf (10), following the report of Frankel (11), in which he treated 57 cases of typhoid fever with subcutaneous injections of typhoid bacilli, found similar results with injections of pyocyaneus bacilli. Though being the first to recognize the action of nonspecific protein therapy, Rumpf's paper was ignored, it being published at the time of the introduction of diphtheria and tetanus antitoxins. However, following him there have been gradually appearing a host of publications acclaiming the nonspecific action of proteins, with Hueppe and Scholl (12) insisting on the nonspecific protein accounting for the entire tuberculin reaction. Schmidt (13) and Saxl (14) introduced milk injections in 1916. They obtained brilliant results in a great variety of infections. Muller (15) and Weiss (16) used milk intramuscularly in gonorrheal infections in 1919, followed by Gellis and Winter (17) and a host of investigators in this country, with excellent results in the majority of cases. Their argument for using milk in preference to serum, vaccines, etc., is that it is easily obtained, easily prepared, bland and nonirritating, and with low bacterial count produces very mild reactions while the therapeutic results are good.

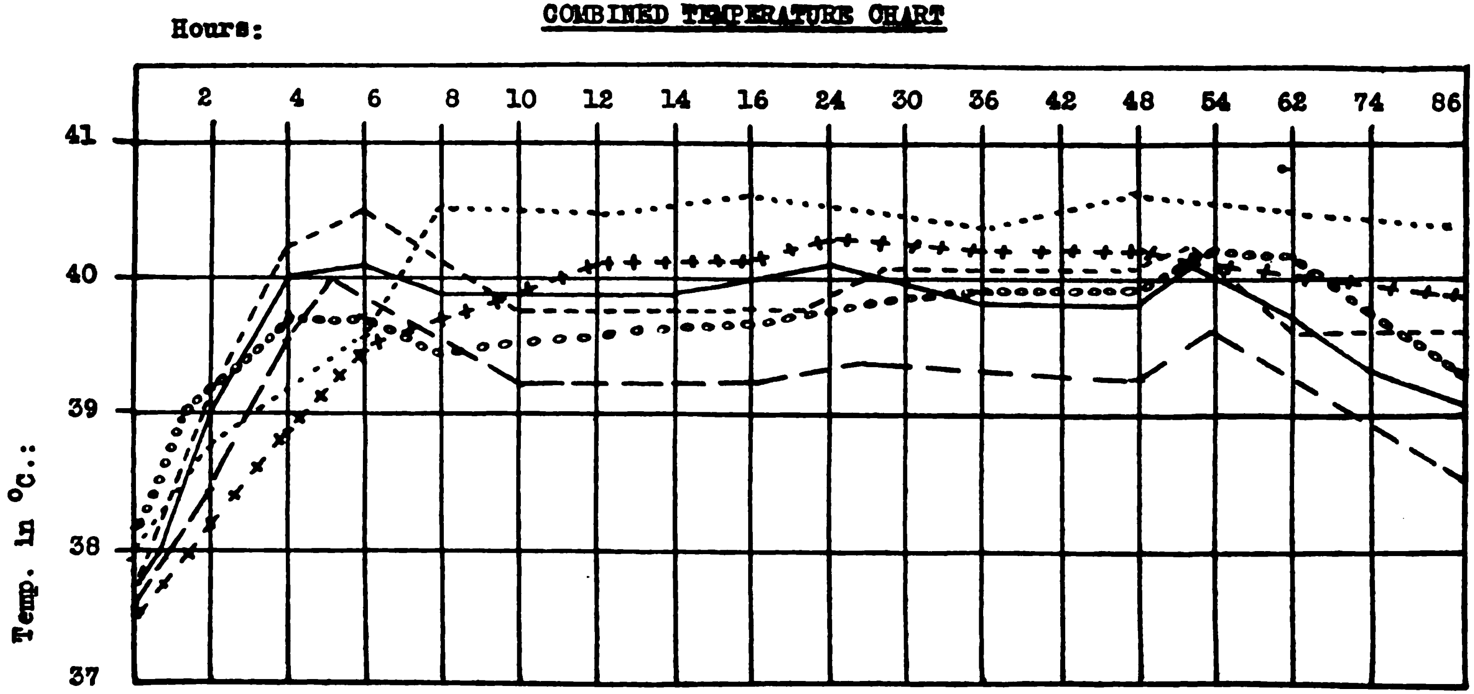
Theory of Foreign Protein Reaction

We can touch only briefly on the theory of foreign protein reactions.

The diaphasic character of focal reaction.—There is a dualistic reaction; first, the negative phase with the tissues more altered than formerly, i. e., pain and swelling more augmented, function impaired and inflammation increased. The increased inflammation is followed by diminution, the positive phase, until a condition of increased healing exists. The intensity of the negative and positive phases is proportional. The negative phase is exogenous in origin; the positive phase is endogenous.

There are two groups of reactions: First, cellular stimulation; second, alteration in permeability of the cells. In the former there is increased secretory activity and an increase in muscle cells and leucocytes. The permeability of the capillaries is at first increased, as evidenced in the great increase in the lymph flow and in concen-

COMBINED TEMPERATURE CHART



——— = Average of all temps. for infected pigs that received mercurochrome.
- - - - - = " " " " " " " " " foreign protein.
+ + + + = " " " " " " " " " combined sugars.
o o o o o o = " " " " " " " " " mercurochrome & combined sugars.
— — — = " " " " " " " " " foreign protein, combined sugars & mercurochrome.
. . . . = " " " " " " " used as controls.

Chart No. 1

tration of the blood; the permeability of the tissue cells is increased with outpouring of enzymes, of fibrogen and prothrombin, of immune bodies. When the first phase has passed, compensation takes place with less permeability of the cells and lessened susceptibility to intoxication. Besides a leucocytosis, in his study of milk injections, Mueller (18) calls attention to the myelocytes and erythrocytes which he believes indicate a profound stimulation of bone marrow. Gellhorn, in his extensive treatment of pelvic infections with milk injections, sums up the action of this nonspecific foreign protein in the fact, proved experimentally, that all cells of the body seem to have a rejuvenating influence with the positive phase of the milk injections but none more so than those cells which have been weakened or paralyzed by infections.

Now, not only does the injection of milk stimulate all the body cells to greater activity, including the increased leucocytosis, the pouring out of enzymes and amboceptors, and an increased cell permeability, but also, by combining with this nonspecific remedy the intravenous injection of mercurochrome, a drug with some specific action, bactericidal and nontoxic, and with high penetrating power this dye is activated and secreted by various glands in larger amounts, as shown by our diphenylcarbazide and mercurochrome kidney function tests in the clinic.

Referring to Table No. 1, columns 2 and 9, the number of cases showing an increase in the function test in the various types of genito-urinary involvement will be noted. Thus, in column 8 is seen the average percentage of kidney function test readings before foreign protein was administered and in column 9 the number of cases in each group which showed an increase in that test with mercurochrome-foreign protein treatment. Fewer of the gonorrheal rheumatic cases showed an increase in the function test, 3 out of 17; also only 1 out of 4 of the acute seminal vesiculitis cases showed an increase. On the other hand, about 75 per cent of the acute urethritis cases, chronic urethritis, and chronic prostatitis cases showed an increase in the mercurochrome kidney function test with the mercurochrome-foreign protein treatment.

In our series of clinical cases the patients injected with milk were remarkably free from severe reactions. None of the patients receiving the combined injections of foreign protein intramuscularly and mercurochrome intravenously manifested severe degrees of anaphylaxis or shock. We believe the lack of such untoward manifestations was due in no little part to the action of glucose and lactose added to the milk thus injected.

Laboratory—Table No. 1

1	2	3	4 and 5		6	7	8	9	10	11	12	13
Class of cases	Total number of cases	Duration of infection	Smears and cultures negative following number of injections listed		Number of cases in which specific organisms demonstrated	Diphenylcarbazide test	Mercurochrome kidney function test	Number of cases showing increase in kidney function test after foreign protein injection	Number of cases positive in culture for gonococcus from seminal fluid	Cultures obtained from seminal fluid other than gonococcus	Number of cases showing positive cultures before treatment	Number of cases in which the infection apparently cleared up culturally
			Foreign protein	1 per cent mercurochrome			*Per cent*					
Acute gonorrheal urethritis	39	2 to 4 days	4	7–9	39	0	70–60	30		*B. coli*	10	2
Acute epididymitis and orchitis	11	2 to 10 days	5	10–12	11	0	70–60	6		*B. coli, B. proteus*	1	1
Acute semino-vesiculitis	4	2 to 4 weeks	5	7–11	2	xxx	60	1	1	*B. coli, Staphylococcus albus.*	4	2
Chronic gonorrheal urethritis	20	2 to 4 months	5–6	7–9	17	xx	60	12	1	*B. coli, Strept. hemolyticus B.*	7	3
Do	29	4 to 6 months	5–7	12–15	13	xx	60–50	16	2	Streptococcus	3	1
Do	15	6 months to 3 years.	5–7	12–25	2	xx	60–50	10	1	Nonhemolytic strept.	1	1
Gonorrheal rheumatism	17	2 months to 3 years.	5–7	12–30	7	xx	50–40	3	1	Extracellular diplococcus. (Gram positive.)	6	5
Acute prostatitis	8	1 to 3 months	5–8	10–12	1	0	70–60	6		Diphtheroids	8	6
Symptom complex												
Chronic prostatitis, 57 cases:												
Sacro-iliac synovitis and lumbar myalgia.	20	Indefinite	5–7	12–15	0	xx	60–50	15		*Micro. catarrhalis*	4	4
Myalgia, synovitis, neuritis, involving thighs and legs.	18	do	5–6	12–20	1	xx	60–50	9	1	*Staphylococcus albus*	3	3
Pains in other parts of body, i. e., arms, chest, high up in spine, and gluteal region.	19	do	5–7	12–16	2	xx	60–50	9		*Staphylococcus albus*, nonhemolytic staph.	2	1
										Micro. tetragenus	3	3
										No growth	69	

Action of Sugar Solutions

Sugar solutions are classified among the nonspecific agents with action similar to other nonspecific agents mentioned above. Baradulin (19) and Audain and Masmonte (20) were among the first investigators who advocated the use of glucose in therapeutics. The last two published their reports upon the use of sugar solutions in massive intravenous doses in the treatment of sepsis, erysipelas, and rheumatism. Later, many investigators in Europe were using this remedy in the treatment of tuberculosis, which led Hasenbein (21) to inject the solution to produce local reaction in general. He has cleared up many cases of gonorrhea in the female with sugar solution injections. Pranter (22) and Duhot (23) have shown that glucose will decrease the toxicity of salvarsan when injected at the same time. Also, many investigators have proved that glucose, when injected, produces a negative phase similar to foreign protein injections. Sholtz and Richter (24) have demonstrated that patients with gonorrheal urethritis will have a considerable increase in the gonococci 3 to 6 hours after the glucose injection, while Silberstein (25) produced a temporary increase in spirochetes. Another characteristic property of glucose in injections is its power to activate salvarsan. This is similar to the action of foreign protein, mentioned above. Silberstein, in a series of very interesting experiments (25), injected trypanosomes into 60 mice with the following results: 30 mice, infected with trypanosomiasis, were each given 1 milligram of salvarsan; 7, or 23.3 per cent, were cured. Thirty mice, similarly infected, were treated with 1 milligram of salvarsan and glucose; 23, or 76.3 per cent, were cured. Thus, it is seen, three times as many mice were cured by combining the glucose with the salvarsan. Steinberg (26) has shown in a large series of clinical cases that after the injection of 0.4 gram of neosalvarsan, spirochetes were present in the primary lesions 24 hours later, while, by combining half that amount of neosalvarsan with glucose, the spirochetes were caused to disappear from the primary lesions in from 6 to 16 hours. He concluded that 0.2 gram of neosalvarsan with 5 grams of glucose is as efficacious as twice that amount of neosalvarsan alone.

Sholtz and Richter, quoted above, in a large series of clinical gonorrhea cases, have shown, as told in their words: "About three hours after the injection of glucose there is considerable increase in the number of gonococci, and if now an energetic antibacterial therapy is instigated, with further glucose, it leads to the cure of uncomplicated gonorrhea in short order. The gonococci disappear after from one to two protargol injections, and in from 10 to 12 days the case is cured in 86 per cent of the cases."

SUGAR AND ANAPHYLAXIS

Another interesting property of sugar injected is shown by the part it plays in the condition of shock. The theoretical and laboratory aspects of this problem have recently been studied by Levine, Gordon, and Derrick (27). They studied the changes in the chemical constituents of the blood following a Marathon race, and showed that a correlation existed between the blood sugar level and the physical condition of the runner at the finish. Those who had normal blood sugar content showed no signs of shock. Four runners who were markedly prostrated, and one who was unconscious, had very low blood sugar—suffering from hypoglycemia. In a very recent article these authors (27), in collaboration with other investigators, studying the effects of hypoglycemia in Marathon runners in a recent race in Boston, not only corroborated their previous findings, but by inducing the runners to ingest moderately large amounts of carbohydrates before the race and to eat glucose candies while running, found after the contest normal sugar levels in all the runners.

Another set of experiments demonstrating the part that sugar plays in the relation to shock is the recently reported experimental work of O'Neill and Manwaring, of Stanford University (28). They proved, in a series of ingenious experiments, that in case of impending shock in animals all the glycogen is drawn from the liver into the blood stream within a few minutes. It is commonly known that glucose given intravenously will combat postoperative shock. Fisher and his coworkers have written serveral far-reaching articles on the subject, especially in connection with insulin (29) (30).

THEORY OF SUGAR ACTION

From the above it can be clearly seen that there are two distinct actions of sugar. One, an action similar to that of the foreign protein, milk, activates bactericidal medicines. It produces a negative and a positive phase in patients. It increases the permeability of the tissues. That direct stimulation of the body cells exists has been proved by Silberstein, while Shultz (31) has demonstrated a marked increase of amboceptors in the blood following its injection, with an increase of opsonins, prothrombin, and a temporary leucocytosis. The other action of sugar injections is to combat shock and all degrees of anaphylaxis. That it is used by the system in this condition there is no question; how it is used is theoretical. However, Cannon (32) claims that by the oxidation of glucose there is increased nourishment of the cells and a distinct stimulation, with the combating of the fall of blood pressure, of the lowered affinity of hemoglobin for oxygen, and of the lowered carbon dioxide com-

bining power with hemoglobin. Also Silberstein and Iacono (33) have shown that glucose diminishes the toxicity of the bacteria that may be present in the milk as well as the sensitiveness displayed by certain patients to intramuscular injections of that type of foreign protein.

The Reason for Combining Milk with Sugar

These two nonspecifics have similar properties in activating mercurochrome, as will be seen below; also they have a remarkable power of cutting short bacterial infection when combined with a bactericidal remedy like mercurochrome. The glucose is a powerful stimulant and nutritive agent and ameliorates the tendency to anaphylaxis, but sugar solution given alone is a hospital procedure requiring considerable care. By adding it to the bland menstrum, milk, and giving the injection deep into the gluteal region, not only is the pain reduced to a minimum, but there is elicited a gradual continuous absorption of the glucose over a period of several hours with clinically very successful results.

In speaking of reaction, three questions naturally arise. First, on what does the reaction of the individual depend? Second, what are the types of reactions and degrees of severity that a patient may undergo? Third, what tests could be used to determine suitable cases for foreign protein-sugar and mercurochrome therapy?

On What the Reaction Depends

The reaction varies, first, with the form of protein; second, with its method of administration—intravenous, intramuscular, subcutaneous; third, its absorption; fourth, the strength of the dose; fifth, the type of infection with which we are dealing; sixth, the physical condition of the patient; seventh, the duration of the disease from which the patient is suffering; eighth, the number of previous injections. The first four of these conditions have already been discussed, while the type of infection, the physical condition of the patient, with the counterindications, the duration of the disease, and the number of injections will be discussed with the clinical case reports below.

Types of Reaction That a Patient May Undergo

The responses which may be elicited from a patient with the foreign protein-sugar-mercurochrome treatment may be classified under any one of four groups, depending on the eight conditions mentioned above:

Group 1.—Cases which show a reaction so slight that it is not noticeable, with practically no febrile reaction, no malaise, and hardly any increase in the existing symptoms during the negative phase.

Group 2.—A temperature between 99–100° F. in one to three hours; slight chills three to six hours after injection, with slight increase in existing symptoms the following day. The next day a subsidence of symptoms and general improvement in condition.

Group 3.—Temperature over 100° but below 102° F. for one to three hours; chills three to six hours after injection; headache, general malaise, with a feeling of pain and "heaviness" similar to a mild attack of "flu," lasting three to six hours during the negative phase, with marked increase in severity of previous symptoms. From 9 to 15 hours after the injection there will be a gradual diminution of symptoms and by the second day the patient notices a decided improvement in his original condition.

Group 4.—These patients, following a decided rigor, may run a temperature above 102° for from 12 to 36 hours, with a severe general malaise and even prostration. The negative phase is prolonged and it may be two to four days before the aggravated symptoms diminish. These are the cases in which there is usually a contraindication to the treatment and in which, contrary to the teachings of Piper (34), the doctor gives an overwhelming dose, in many cases as a last resort. What Piper says about mercurochrome is no less applicable to the injections of foreign protein and sugar.

Tests to be Used to Determine Suitable Cases

We published in a recent paper two tests which we devised, first, for determining the amount of mercurochrome in the seminal fluid, and, second, for the contrasting of colored solutions of known strength similar to the phenolsulphonphthalein test. These test are reported in detail in a former article (5).

Note.—To render the diphenylcarbazide test very sensitive in testing for mercury with mercurochrome in body fluids it is necessary to separate all the mercury from the phenol radical with nascent chlorine and then neutralize the solution. The method in detail is as follows: Add 0.2 c. c. of a cold saturated solution of potassium chlorate to the seminal fluid to be examined and then 1 c. c. of 2 Normal hydrochloric acid. This whole solution is kept in a water bath until it becomes decolorized—usually 30 minutes. Then 2 c. c. of 2 Normal ammonium hydrate is added to the solution and it is kept in the water bath 15 minutes longer. Finally, neutralize with acetic acid with brom-thymol-blue as an indicator (0.04 per cent in 95 per cent alcohol). Begin the titration to neutralize the solution with 1 Normal acetic acid; when the yellow color begins to appear, indicating approaching neutrality, titrate with 1/20 Normal acetic acid. The solution is neutralized when the color is a decided yellow. If the solution is even slightly acidulated it becomes a grass green. Dissolve the diphenylcarbazide in either carbon tetrachloride or ether.

Milk Injection Test

In treating patients with foreign protein injections it is advisable to determine in advance whether a hypersensitiveness exists for the particular protein to be used. Scores of such tests have been devised but the simpler methods that are very efficient pertain to the injection of minute quantities of the substance into the epidermis. Such tests have been advocated by many writers and may be classified in two types as recommended by Gottlieb (35), Walker (36), and Rackemann (37). One, the superficial test, like the modern method of smallpox vaccination, and, two, the intradermal injection test. Rackemann claims that the intradermal test is far more sensitive and we have used this test in our determinations. It is evident that the syringe and needle should be chemically and bacteriologically clean and the milk a sterile solution. The injection should produce no reaction in a normal individual. Two-tenths cubic centimeter of the sterile milk is injected between the layers of the skin on the flexor surface of the forearm. If the test is positive, within 5 to 15 minutes there appears at the site of inoculation an urticarial wheal, having a sharply defined irregular border; it is usually pale in color but is surrounded by a zone of bright erythema.

Foreign Protein Injections Reduce Number of Cases Showing Contra-indications for Mercurochrome

It has been interesting to note in this series of 200 cases that the foreign protein injection, by activating the mercurochrome, stimulating the increased secretion of the dye in the glands of the body, and increasing the general resistance and reactive power of the system, in many cases formerly showing a low diphenylcarbazide and mercurochrome kidney function test, caused a marked reduction in the number of cases in which mercurochrome treatment could not be continued with safety.

Preparation of Milk-Sugar Solution

The following method of preparing the milk-sugar solution for injection in our clinical cases and experimental work was used. Certified milk, 250 c. c.; standard brand condensed milk (without addition of sugar), 250 c. c.; glucose, 50 grams; lactose, 50 grams. Sterilize 10 minutes in autoclave (15 pounds pressure). This gives practically a 20 per cent solution of combined sugar.

Method of Taking Cultures

It seems advisable to emphasize a few important points to be observed in making the cultures from the acute and chronic cases. We used Hall's testicular agar and plain agar with superimposed coagulated blood as culture media. In cultivating the gonococcus from the seminal fluid, our best results were obtained by using Hall's testicular agar with the addition of 1/100,000 per cent gentian violet. This dye was added to restrict the growth of *Staphylococcus albus* commonly found in the urethra. With an electrically controlled incubator in the clinic, where most of the chronic cases were treated, and at the United States receiving ship, where we treated a large proportion of the acute cases among the sailors, we kept the media at 37.6° C. until ready for use. In the acute cases, after cleaning the glans with soap solution and alcohol, a standard platinum loop of purulent material expressed from the meatus was immediately smeared over the warm media in the petri dish and incubated. With the chronic cases, after cleaning the glans, the prostate was massaged. Allowing the first two drops to pass, as these contain a preponderance of staphylococci normally present in the urethra (Hogan) (38)), the remaining secretion was collected in small sterile petri dishes containing warm normal salt solution and immediately spread over the warm culture media by the cotton swab method. It is very important in obtaining body secretions that the material be not allowed to become chilled, for in so doing one may dampen or kill the growth otherwise obtainable.

As an example of the cultures which may be obtained from chronic genito-urinary cases there are tabulated in Table No. 1, columns 11, 12, and 13, the results in using the technic above described. In columns 11 and 12 are shown 55 cultures of various types and combinations of bacteria out of 119 cases; that is, in 44 per cent of the prostatic secretions cultures were obtained. In column 13 it will be noted that a large number of secretions were cleared of the particular infections with the mercurochrome, foreign protein, and sugar treatment. The colon bacillus was the most resistant to treatment.

Treatment—Table No. 2

Class of cases	Total number of cases	Duration of infection	Total number treated with mercurochrome and foreign protein	Total number apparently cured with only mercurochrome and foreign protein	Total number treated with mercurochrome, foreign protein, and other medication	Total number not improved with mercurochrome and foreign protein	Number of cases which did not receive complete course of therapy	Symptoms of pain, general malaise, etc., relieved
Acute gonorrheal urethritis	39	2 to 4 days	39	19	20	0	0	----------
Acute epididymitis and urethritis	11	2 to 10 days	11	5	6	0	0	----------
Acute semino-vesiculitis	4	2 to 4 weeks	4	2	2	0	0	----------
Chronic gonorrheal urethritis	20	2 to 4 months	20	10	10	0	0	----------
Do.	29	4 to 6 months	29	10	15	4	0	----------
Chronic gonorrhea	15	6 months to 3 years	15	6	6	3	0	----------
Gonorrhea rheumatism	17	1 to 6 months	17	9	5	3	0	----------
Acute prostatitis	8	1 to 3 months	8	4	2	0	2	----------
Symptom complex.								
Chronic prostatitis, 57 cases:								
Sacro-iliac synovitis and lumbar myalgia	20	Indefinite	20	5	10	3	2	15
Myalgia, synovitis, neuritis, involving thighs and legs	18	do	18	8	6	2	2	14
Pains in other parts of body; i. e., arms, chest, high up in spine, and gluteal region.	19	do	19	8	8	3	0	16

Summary of Clinical Cases Reported in Tables 1 and 2

Ten to fifteen cubic centimeters of 1 per cent mercurochrome in 50 per cent glucose solution were given intravenously, and 5 to 10 cubic centimeters of the milk preparation deep into the gluteal region, every 48 hours while the patient was being treated. Of the acute gonorrheal urethritis cases, 39 in number, all showed a negative phase after the first injection, with increased urethral discharge beginning within 3 hours and lasting 3 to 6 hours. In 19, or nearly 50 per cent of the cases, the discharge stopped after the third milk-sugar and mercurochrome injections; 10, or over 25 per cent, cleared up with the fourth, and the remaining 9, after the fifth injection. What is most interesting is that nearly half of these cases received no other treatment than these injections. Of the chronic gonorrheal urethritis cases, 20 with a history of disease lasting 2 to 4 months; 29, 4 to 6 months; 15, 6 months to 3 years—64 cases in all—about 50 per cent cleared up with 5 to 7 injections of milk solutions and 8 to 10 of mercurochrome with no other treatment. The remaining 50 per cent cleared up with these injections and other treatment after 5 to 7 injections of milk solution and 10 to 12 of mercurochrome. Among the chronic prostatitis cases with low back pain, 20 in number, in 25 per cent of the cases the back pain entirely disappeared with milk-mercurochrome-massage treatments; 50 per cent with milk-mercurochrome massage and other treatment; 15 per cent were not improved, and 10 per cent did not complete the therapy. Among the 18 chronic prostatitis cases with all types of joint, nerve, and muscle involvement of the legs, 44 per cent were cured of their leg conditions, including pain and stiffness, after five milk injections and massage; 30 per cent after seven injections and other treatment; 10 per cent were not improved. Here again it is an interesting fact, that in 78 per cent of this series pain was relieved, and the patients became able to walk naturally, etc., as a result of this treatment. Of 19 chronic prostate cases with referred pain in other parts of the body, 42 per cent were relieved by sugar-milk-mercurochrome injections and massage; 52 per cent were relieved with these injections and other medication, and 6 per cent were not improved. In Table No. 2 it is shown very clearly how remarkably the acute cases were cleared of the gonococcus with this combined injection method. The results are similar to those of Sholtz and Richter quoted above. Among the chronic prostate cases a large percentage of the cultures also cleared up.

Animal Experimentation

In order to determine the effect of combining mercurochrome with foreign protein and sugar in the therapeutic treatment, and to ascertain, if possible, the particular effect of such therapy, we were in-

17 hich died—autopsy findings	18 Blood cultures	19 Animals killed on 14th day; autopsy findings	20 Survived—blood culture	No. of guinea pig
		Negative	Negative	1
		do	do	2
		do	do	3
		do	do	4
ction	*Staphylococcus aureus*			5
		Negative	Negative	6
		do	do	7
; general infection	Mixed			[1] 8
		Negative	Negative	9
ction	*Staphylococcus*			10
		Negative	Negative	11
ction	*Staphylococcus*			[1] 12
		Abscess	*Staphylococcus.*	[1] 13
	Mixed			[1] 14
ction	*Staphylococcus*			[1] 15
		Abscess	*Staphylococcus.*	16
ction	*Staphylococcus*			17
	Mixed			18
		Negative	Negative	19
		Abscess	*Staphylococcus.*	20
ction	*Staphylococcus*			[1] 21
	Mixed			[1] 22
ction	*Staphylococcus*			[1] 23
	do			[1] 24
	do			[1] 25
		Negative	Negative	26
ction	*Staphylococcus*			27
	do			28
		Negative	Negative	29
		Abscess	*Staphylococcus.*	30
		Negative	Negative	[1] 31
		do	do	[1] 32
		do	do	[1] 33
		do	do	[1] 34
		do	do	[1] 35
		do	do	[1] 36

duced to conduct experiments on animals. We infected a certain number of them with a definite strain of bacteria of high virulence and treated small groups with various combinations of the three drugs. Also, we infected others as controls which did not receive therapeutic treatment. Another group of controls was not infected but was given various forms of nonspecific therapy.

Dosage

It will be noticed in Table No. 3, columns 6 and 11, that 0.1 c. c. mercurochrome was given intraperitoneally. Since the minute ear veins of the guinea pigs were used for taking white blood counts it was found impractical to give the mercurochrome intravenously. Assuming 2 mgms. of the dye per kilogram of body weight as the maximum dose per pig, we arbitrarily increased the dose 50 per cent and gave 3 mgms. per kilogram intraperitoneally to the animals, In column 2 of the table it will be seen that the guinea pigs averaged 353 grams, or a little over one-third kilogram in weight. The mercurochrome was a 1 per cent solution (0.1 c. c. equals 1 mgm.). Since the animals average about one-third kilogram in weight and we gave them 3 mgms. per kilogram, 0.1 c. c. of the 1 per cent solution was the proper dosage. The foreign protein and sugar preparations used in these experiments were identical to the solutions used in the clinics. One-tenth c. c. of the milk-sugar injection in the guinea pigs approximates the dosage given to patients per body weight.

Summary of Table No. 3

Guinea pigs were inoculated with a staphylococcus culture from the laboratory of Doctor Walker of Hooper Foundation. This culture was originally obtained from human boils, passed through 20 mice, and the spleen and liver of the last mouse kept on ice until ready for use, at which time a 24-hour beef broth culture was prepared.

Twenty animals were injected subcutaneously with 0.5 c. c. of the 24-hour culture. Five animals were used as controls and given no therapy. In the 15 given mercurochrome, foreign protein, and sugar, the injections were administered right after they were infected and 48 hours later. It will be seen in the table that mercurochrome was given to guinea pig number 16; foreign protein to 4, 10, and 17; sugar to 5, 6, and 16; mercurochrome and sugar to 1, 2, and 20; mercurochrome and foreign protein to 3 and 19; and mercurochrome, foreign protein, and sugar to 7, 9, and 11. In the second group of guinea pigs—numbers 21 to 30 inclusive—all were given 0.8 c. c. of the broth culture subcutaneously and the first five used as controls and given no therapy. The other five were given combinations of the three drugs as seen in the table, the dosage being repeated 48

hours later. The remaining six pigs, numbers 31 to 36, inclusive, were used as a third set of controls and were not infected but were given, as can be seen, several combinations of the three drugs, the dosage being repeated in 48 hours. White blood counts were made on all animals before inoculation, as shown in column 4 of table No. 3; also the count was taken 24 hours later—column 9—and 72 hours after inoculation—column 14. Animals that died were autopsied and blood cultures obtained—columns 14 and 15. Animals that survived were killed in 14 days; autopsy findings and blood reports are recorded in columns 19 and 20.

Results of Experiments

Of the first series of five controls, four died. The average time that these four lived after inoculation was 94 hours. Of the second set of five controls, with increased dosage of bacterial inoculation, all died, their average duration of life after inoculation being 70 hours, or 24 hours less than the first group. These received nearly double the dose of bacterial inoculation. The third set of six controls all lived, having been uninoculated, though given various combinations of mercurochrome, foreign protein, and sugar. It will be noted in the last series of controls that the guinea pig given only mercurochrome had a slight leucocytosis, that the animals given protein and sugar had a decided increase in leucocytes, and the animal given the combination of the three drugs had the highest white count after both injections—Table 3, columns 9 and 14. Among the infected animals the leucocyte counts are worthy of note. With the exception of the animals that had pneumonia, the highest counts were found in those that recovered, and, although the sugar and protein injections caused higher counts than in the infected controls, yet the highest leucocytosis was found in the infected animals given the combination of the three medicines. Also, in observing the records of the infected animals we find that two given sugar alone and two given protein alone died, while those given only mercurochrome recovered. However, it is interesting to note that the infected guinea pigs given mercurochrome, foreign protein, and sugar apparently were less sick and recovered in shorter time than the others infected and treated therapeutically.

Summary of Chart No. 1

Temperatures of all the guinea pigs were taken just prior to inoculation and thereafter at various designated hours as recorded. These large groups of temperature figures are rendered of easy elucidation by taking an average of the values for each group of guinea pigs treated and graphing the curves as seen in the last chart.

The animals having the lowest temperatures in both series are those injected with mercurochrome, foreign protein, and sugar.

The groups of guinea pigs that showed the next lowest temperature curves were those that received mercurochrome and sugar, while the highest temperature curves, with the exception of the infected controls, were the animals that were injected with foreign protein alone. From the above experimentation it appears that the sugar, added to the foreign protein and given along with mercurochrome, aids in combating shock, in the reduction of the toxemia of infection, and probably, with the foreign protein, activates the mercurochrome in its bactericidal effect.

Conclusions

1. By the use of the diphenylcarbazide test for mercury in the seminal fluid and the mercurochrome kidney function test it is possible, with the first intravenous mercurochrome injection, to detect patients that are not suitable for the continuous use of the drug.

2. By the Rackemann skin test one can detect within 15 minutes if a patient is sensitized to nonspecific foreign protein.

3. By observing careful technic and with the proper selection of media it is possible to obtain cultures of bacteria in a large percentage of acute and chronic infections.

4. Milk and sugar, when injected alone, each have a diaphasic action with a negative followed by a positive phase. Sugar added to milk alleviates shock which may result if foreign protein is used alone.

5. There are a number of disease conditions in which this treatment is contraindicated. If the cases are not properly selected, in giving this combined injection, serious reactions may result.

6. In the animal experimentation, the combined use of mercurochrome, foreign protein, and sugar cleared up staphylococcus infection more decidedly and in a shorter time than when either of the drugs was used alone.

7. Milk and sugar activate the mercurochrome, increase its bactericidal power, penetration, and permeability into the tissues, and stimulate a greater excretion of the dye from the glands, as is proved by the diphenylcarbazide and mercurochrome kidney function tests.

8. The most striking results are rapidity with which acute gonorrhea cases will respond to the combined mercurochrome-foreign protein-sugar treatment and the few complications which ensue.

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BIBLIOGRAPHY

1. Young, H. H., White, E. C., and Swartz, E. O.: A new germicide for use in the genito-urinary tract, mercurochrome-220, J. A. M. A. 73:1483-1491:(Nov. 15) 1919.
2. Piper, E. B.: The treatment of puerperal sepsis by the use of mercurochrome, with report of animal experimentation—the chemical disinfection of the blood, Am. J. Obst. and Gynec., 4:532:(July) 1922.
3. Young, H. H.: Treatment of infections—general, local, and urinary—with the intravenous injection of mercurochrome, Surg., Gynec. and Obst., 40:97-104:(January) 1925.
4. Young, H. H., Hill, J. H., and Scott, W. W.: Treatment of infections or infectious diseases with mercurochrome-220 soluble, Arch. Surg., 10:813-924:(May) 1925.
5. Redewill, F. H., and Potter, J. E.: Mercurochrome-220 soluble in genito-urinary diseases. Results of intravenous treatment in five hundred and twenty-five cases, J. A. M. A., 84:1891-1897:(June) 1925.
6. Kyrle: Fieber ein wesentlicher Heilfaktor in der Syphilistherapie, Wien klin. Wchnschr., 30:707:1917.
7. Scherber, G.: Ueber die Wirkung intramuskularer Milchinjektionen auf die latente und manifeste Syphilis unter Mitteilung der Erfahrungen mit der Fiebertherapie im allgemeinen, Wien Med. Wchnschr., 47:1177:1917.
8. Peterson, W. F.: Protein therapy and nonspecific resistance, Monograph, 1922. MacMillan & Co.
9. V. Behring: Experimentelle Analysefund Theorie der anaphylaktischen und apotosischen Vergiftung, Deutsch. med. Wchnschr., 50-38-57:1914.
10. Rumpf, T.: Die Behandlung des Typhus abdominalis mit abgetödteten Culturen des Bacillus pyocyaneus, Deutsch. med. Wchnschr., 19:897:1893.
11. Frankel, E.: Ueber specifische Behandlung des Abdominaltyphus, Deutsch. med. Wchnschr., 19:985:1893.
12. Hueppe and Scholl: Ueber die Natur der Koch'schen Lymphe, Berl. klin. Wchnschr., 28:88-193:1891.
13. Schmidt, R.: Ueber Proteinkörper Therapie und über parenterale Zufuhr von Milch, Med. Klin., 12:171:1916.
14. Saxl, P.: Ueber die Behandlung von Typhus mit Milchinjektionen, Wien klin. Wchnschr., 89:1043:1916.
15. Muller, E. F.: Die myeloische Wirkung der Milchinjektionen, Med. Klin., 19:440:1918.
16. Weiss, A.: Ueber subkutane Milchinjektionen in der Nachbarschaft gonorrhoischer Krankheitsherde, Wien Klin. Wchnschr., 32:840:1919.
17. Gellis, S., and Winter, J.: Ueber Milchinjektionenbehandlung gonorrhoischer Komplikationen, Arch. f. Dermat., 126:267:1918.
18. Muller, E. F.: Same as 15.

19. Baradulin, G. T.: "Intravenous Injection of Glucose."
20. Audain, G. and Masmonte, F.: Traitement des septicemies par les injections massives intravenous de serum suere isotonique (action leucogène), Press. Med., 25: 641: 1917.
21. Hasenbein, H.: Ueber Rohrzuckerinjektionen zur Erzeugung von Herdreaktionen, München. med. Wchnscher., 67: 1222: 1920.
22. Practer, V.: Ueber eine kombnierte Behandlungsmethode mit Zucker unter Salvarsan, Wien klin. Wchnschr., 34: 16: 183: 1921.
23. Dubot: Injection of glucose with salvarsan, Press. Med., 6: 1922. Rev. d'urol. et de dermat., 4: 1921.
24. Sholtz, W. and Richter, C.: Ueber die Wirkung intravenöser Traubenzuckerinjektionen auf die Haut und ihre Erkrankungen, Berl. klin. Wchnschr., 47: 22: 1522: 1921.
25. Silberstein, S.: Enhancement of bactericidal remedies by intravenous injection of hypertonic solutions of glucose, Deutsch. med. Wchnschr., 49: 345: (Mar. 16) 1923.
26. Steinberg, V. O.: Ueber die Erhöhung der Spirilloziden Wirkung des Salvarsans in Verbindung mit Traubenzucker, Deutsch. med. Wchnschr., 50: 1523: 1921.
27. Levine, S. A., Gordon, B. and Derrick, C. L.: Some changes in the chemical constituents of the blood following a marathon run, J. A. M. A., 82: 1778–1779: 1924.
28. O'Neill, F. G. and Manwaring, W. H.: Quantitative changes in hepatic glycogen in anaphylactic shock, J. A. M. A., 84: 1102: (April 11) 1925.
29. Fisher, D. and Snell, M.: Treatment of shock with glucose infusions and insulin, J. A. M. A., 83: 1906–1908: (Dec. 13) 1924.
30. Fisher, D. and Mensing, E.: Insulin and glucose treatment of surgical shock and non-diabetic acidosis, Surg., Gynec. and Obst., 40: 545–555: (April) 1025.
31. Schultz: The effect of intravenous glucose injections on the blood, Arch. f. Dermat., 35.
32. Cannon, W. B.: Traumatic shock, Keen's Surgery, vol. 7, pp. 296–315, 1921.
33. Iacono, I.: Glucose injections with vaccines, Reforma Med., 40–530–531: (June 9) 1924. Ab., J. A. M. A., 83: 310 (July 26) 1924.
34. Piper, E. B.: Blood stream infection treated with mercurochrome–220 soluble intravenously, Am. J. Obst. and Gynec., 9: 7–17: 1923.
35. Gottlieb, C. H.: Results of tests in hay fever and asthma, J. A. M. A., 75: 814: 1920.
36. Walker: Frequent causes and the treatment of perennial hay fever, J. A. M. A., 75: 782: 1920.
37. Rackemann, F. M.: Skin tests with foreign proteins in various conditions, Am. J. Med. Sci., 163: 87–100: (Jan.) 1922.

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CLINICAL NOTES

HETEROTAXY[1]

WITH REPORT OF CASE OF TOTAL HETEROTAXY

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Heterotaxy is a condition in which the viscera are on opposite sides to that upon which they are found normally. It may be congenital or acquired.

Congenital heterotaxy may be either total or partial. Total heterotaxy is a condition in which all the viscera are transposed. To this condition the term *Viscerus situs inversus* has been applied. This picture is a "mirror image" of the normal position of the viscera. Total heterotaxy may not have associated congenital defects. It is upon this point that the prognosis pivots. Partial heterotaxy is a condition in which one or more, but not all, of the viscera are on the opposite side to the normal. This condition is rare. Jones (1), of Liverpool, has reported three cases, as follows:

(*a*) Transposition of viscera, with heart in normal position.

(*b*) Complete inversion of the thoracic organs and a liver situated in the midline.

(*c*) Inversion of heart only.

Parsons-Smith reported two cases of partial heterotaxy, both of which were dextrocardia alone. It is this type in which the prognosis should be guarded. Partial heterotaxy may or may not have associated with it congenital defects of the heart and greater vessels.

Acquired heterotaxy usually involves only the heart, and the picture is not a mirror image of the normal, but is a displacement of the organ without a transposition of its cavities and greater vessels. The displacement may take place before or after birth. This condition is best diagnosed by the electrocardiogram.

ETIOLOGY

Congenital heterotaxy is due to an anomaly in the development of the embryo. For example, the two cardiac tubes fuse into one about the fifteenth day (2), and an auricular, ventricular, and bulbar subdivision becomes evident (3). The tube soon becomes bent on itself, which determines the future axis of the heart. In congenital transposition the primitive tube bends into a contra sigmoid Ƨ instead of the normal sigmoid S manner. This has been explained by assuming that the embryo lies in an abnormal position within the chorion, so that its left side lies closer to the blood supply (4).

[1] From U. S. Naval Hospital, Chelsea, Mass.

Acquired or pseudo-heterotaxy, which is really limited to dextrocardia, may occur before or after birth, and may be caused by various factors, such as tumors of the left lung, left pyothorax, left hemothorax, left hydrothorax, or left pneumothorax, which displace the heart to the right by virtue of their pushing force, or chronic fibrosis of the lungs with associated fibrous adhesions to the pericardium and to the lateral thoracic wall, which may displace the heart to the right by virtue of its pulling force.

Diagnosis

The diagnosis of heterotaxy is not difficult to make. It is usually made by the routine physical examination. Total inversion of organs without congenital defects gives no clinical symptoms and is recognized accidentally during the routine examination. The normal cardiac dullness to percussion is elicited on the right side instead of on the left. The apex beat is on the right, just opposite the normal position. On auscultation, the heart sounds are heard best on the right side, usually in the midclavicular line at the fifth interspace, and the breath sounds, as well as spoken and whispered voice sounds, are heard loudest at the left apex instead of the right apex as usual. The hepatic dullness is elicited in the left lower chest, as contrasted with the right lower chest in the normal. Splenic dullness may be elicited on the right side. The above findings are probably all that will be noted in making a routine physical examination. Radiograms of the chest will show the heart located in the midline and to the right, with the apex of the heart to the right. Barium taken by mouth with simultaneous fluoroscopy will show the esophagus to the right, cardiac orifice of the stomach to the right, and pylorus pointing to the left. Barium enema will show the descending colon on the right and the ascending colon on the left side. An electrocardiagram will show an inversion of the QRS, T, and P waves in lead 1, with a rather small QRS in lead 2.

Partial heterotaxy is somewhat more difficult to diagnose than is the total form, especially if the heart is in the normal position and the other viscera transposed, because it is usually the abnormal position of the heart that is first noted. If the partial heterotaxy is a simple dextrocardia, the diagnosis is made by the abnormal situation of the heart and greater vessels, and by the electrocardiogram. It is the electrocardiogram which differentiates this condition from dextroversion of the heart, or acquired dextrocardia. However, if the partial heterotaxy is an inversion of all the viscera except the heart, it is usually the liver dullness on the left side that incites attention to the abnormality. The diagnosis of this condition is made by fluoroscopy with barium meal and enema and the finding of the liver dullness on the left.

The importance of making the diagnosis of an existing heterotaxy is paramount, not only from the standpoint of symptoms that may arise from partial heterotaxy, but also because of the aid that it affords in making correct and prompt diagnoses of other conditions apart from heterotaxy. In total transposition, the appendix, liver, gall bladder, and duodenum are on the left side. The spleen is on the right. An acute appendicitis in an unrecognized total heterotaxy would probably not be diagnosed in the male and wrongly diagnosed as salpingitis in the female. Difficulty would also be encountered in making a diagnosis of hepatitis, cholangitis, cholecystis, cholelithiasis, duodenal ulcer, splenitis, perisplenitis, and hepatic abscesses; while an enlarged spleen from malaria, typhoid, splenomegaly, etc., would probably be diagnosed as hypernephroma or an enlarged floating kidney. Also, a tuberculous process in the right apex, without evident râles, might be mistaken for the normal decreased resonance, increased breath sound, and increased spoken and whispered voice of the right apex of the normal individual.

Symptoms

Total heterotaxy with no congenital defects does not produce any symptoms and does not incapacitate the individual. Partial heterotaxy is of serious moment (5). Symptoms of incompetence are bound to appear sooner or later. The symptoms are dyspnea, palpitation, insomnia, faintness, and pain. They result from a general visceral overcrowding, the liver impeding the movements of the heart and upper lobes of the *right* lung in a case of dextrocardia alone, but impeding movements of *left* lung in case of transposition of all viscera without dextrocardia. The patient lays stress on the pains experienced both during effort and when resting. These pains, due to visceral overcrowding, are both local and referred—local when they denote pressure upon the intercostal nerves or brachial plexus; referred when the vagus or its intracardiac endings suffer inordinate stimuli. Dextrocardia without transposition of other viscera is usually, if not always, complicated by actual malformations of the heart and greater vessels, such as perforated ventricular septum, patent foramen ovale, pulmonary stenosis, and patent ductus arteriosus.

Advice to Patient

Patients with total heterotaxy should be informed of the condition and advised when seeking medical or surgical advice or treatment to mention its existence to the consultant. Patients with partial heterotaxy should be advised to select light occupations and guard against strenuous exercise or anything throwing excess burden on the heart.

Occurrence

Heterotaxy is more frequent in males than in females. It occurs once in about four thousand persons (6). There are over 200 cases on record. Gruber (7) reported 79 cases, 49 of which were in males, 19 in females, while in 11 the sex was not mentioned. Partial heterotaxy is rare, there being only a few cases on record. All have shown signs of cardiac incompetence before the age of 40 years.

Report of Case of Total Heterotaxy

Patient A. A., a robust, well developed, and well nourished white male, 29 years of age, was admitted to the United States Naval Hospital, Boston, Mass., July 7, 1925, with the diagnosis of arthritis of both shoulder joints. He has never had any cardio-respiratory difficulty except whooping cough in childhood and some obstruction of the nares, due to a traumatic double deviation of the nasal septum. He has always been in the best of health, his only ailments having been measles, whooping cough, fractured femur, fractured nose, and a traumatic injury to shoulders (pack-carrying) which developed into a bilateral tenosynovitis of the long head of the biceps, and chronic arthritis of both shoulder joints. He had an operation January 18, 1922, in the United States Naval Hospital, Boston, Mass., for bilateral tenosynovitis of the long head of the biceps, but the arthritis of the shoulder joints has persisted.

He is one of 10 children. The other members of the family have organs in normal position. His only child, a son, is also normal.

Upon examination, the apex impulse was found to be in the fifth interspace in midclavicular line to the right. The cardiac dullness was S. C. D., 5 cm.; M. L., 3.5 cm.; M. R., 9.1 cm. The internal transverse diameter of the chest was 28.6 cm. The heart sounds were clear, good rhythm, regular, rate 72 per minute. There were no murmurs and absolutely no signs of cardiac imcompetence. Systolic blood pressure, 122 and diastolic, 88. The chest was negative throughout. At the left apex there was bronchovesicular breathing, increased whispered voice, and some dullness, which is normal for the right apex in a normal individual. The liver dullness was on the left instead of the right; radiograms and fluoroscopy showed the esophagus to be slightly to the right of the midline, cardiac orifice to the right, with the pylorus pointing to the left, and the air bubble to the right. At the end of six hours there was some gastric residue. The head of the barium meal was in the ascending colon, which was on the left instead of the right. The electrocardiogram showed a typical dextrocardia with a slight right ventricular preponderance.

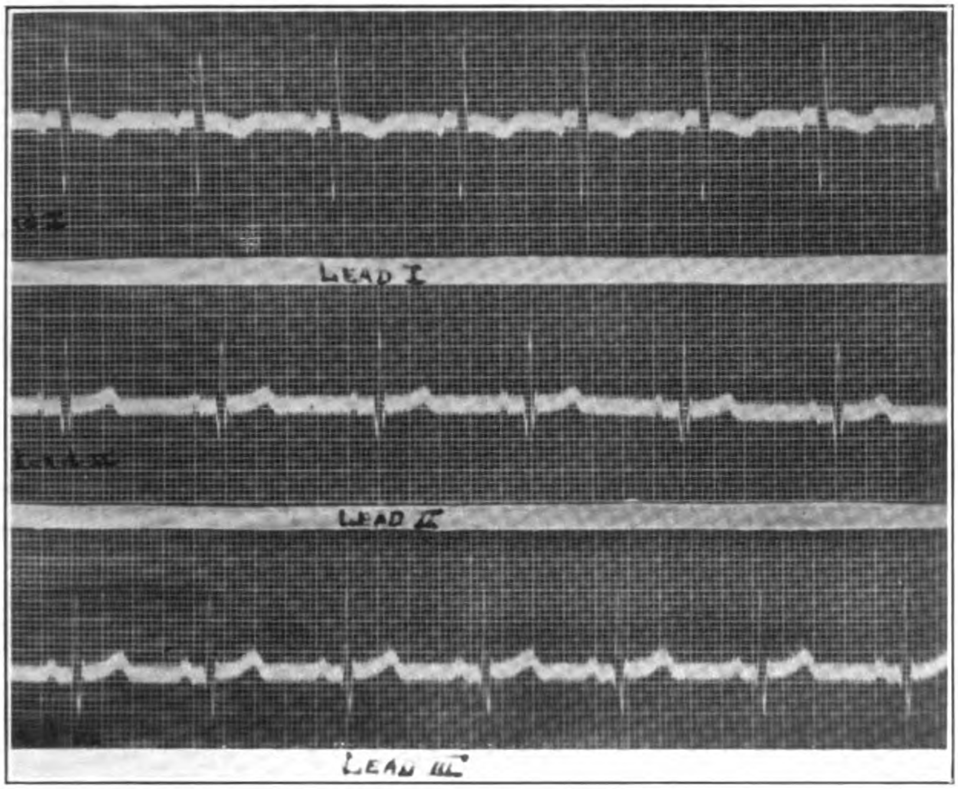

FIG. 1.—ELECTROCARDIOGRAM SHOWS INVERSION OF QRS, T, AND P WAVES IN LEAD I; SMALL QRS IN LEAD II; UPRIGHT QRS IN LEAD III

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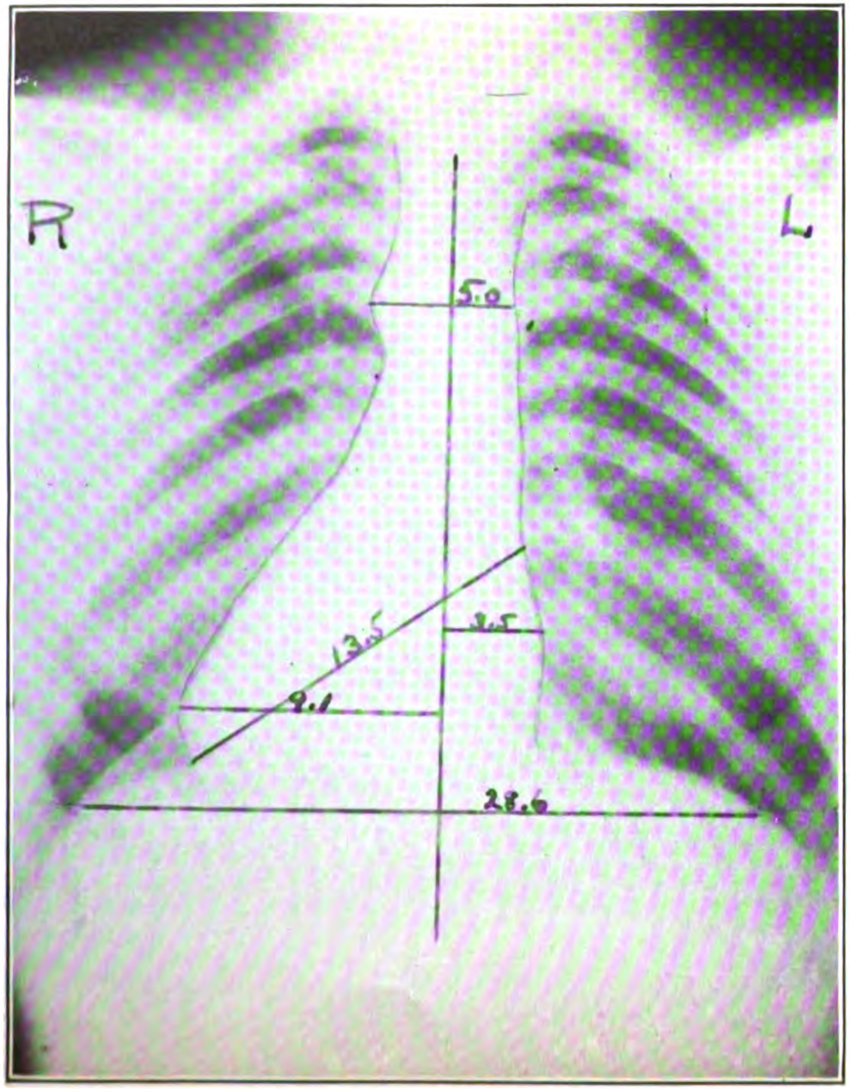

FIG. 2.—SHOWING INVERSION OF THE HEART

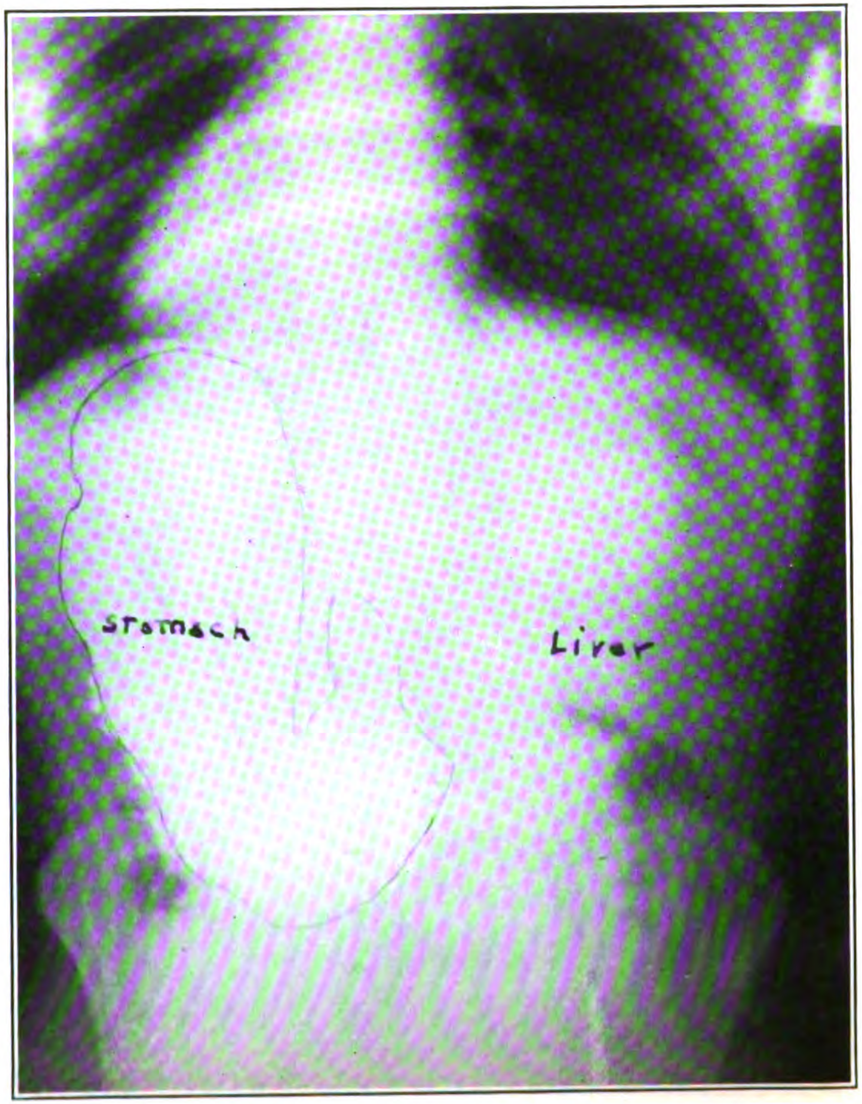

FIG. 3.—SHOWING INVERSION OF THE STOMACH AND LIVER

Electrocardiogram report by Doctor Pratt is as follows: "Rate 70; rhythm normal. There is inversion of the QRS, T, and P waves in lead I; a rather small QRS in lead II, with QRS, upright in lead III. There is an apparent slight ventricular preponderance, as shown by the deep S wave (inversion) in lead I, and the upright R in lead III. Typical dextrocardia."

Figures 2 and 3 show inversion of heart, stomach, and liver.

Patient was discharged from hospital August 7, 1925, to take out-patient treatment at the Veterans' Bureau for chronic arthritis of both shoulder joints.

BIBLIOGRAPHY

(1) Jones, H. W: Types of dextrocardia, Brit. Med. J., 1924 (Jan. 26), p. 148.
(2) Willins, F. K.: Congenital dextrocardia, Am. J. Med. Sciences, January and June, 1919.
(3) Abbot, M. E.: Congenital cardiac disease, J. of Med., Philadelphia. Lippincott, 1908, IV, p. 323.
(4) Bryce, T. H: Embryology, Quain's Anatomy, N. Y., 1908, p. 63.
(5) Basil Parsons-Smith: A note on dextrocardia, complete and incomplete, The Lancet, Dec. 13, 1919, p. 1076.
(6) Jones, W: Types of dextrocardia, Brit. Med. J., June, 1924, p. 147.
(7) Singer, S: Complete heterotaxy, J. A. M. A., Nov. 18, 1922.

LEUKOPENIA IN DISEASE [1]

By D. L. Beers, Lieutenant (Junior Grade), Medical Corps, United States Navy

An absolute reduction in the number of white cells in circulating blood occurs in many conditions and as an accompaniment of many varied physical findings which prevents its being pathognomonic of any certain condition, but its presence is of great value in a differential diagnosis involving, more especially, groups of diseases with clear-cut symptomatology.

An admirable illustration of such a departure from the normal blood picture is the case of R. T., who was a patient in the United States Naval Hospital, Chelsea, Mass., from June 6, 1925, until August 28 of the same year. He was a young man 20 years of age, who had been a bugler in the Marine Corps during the war, and possessed an excellent physique. His chief complaint on entrance to the hospital was of heart attacks, consisting of fainting spells and palpitation. His temperature at this time was 98.6° Fahrenheit; pulse, 96 per minute; and blood pressure, systolic 136, diastolic 84. He was admitted from the United States Veterans' Bureau as a cardiac case, with advice as to special observation and treatment of any circulatory disorder which might exist. The past history obtained showed one feature of special interest in that as he was blowing a call he suffered a severe pain in the left chest and corresponding side of his neck. The following day he collapsed and hospital care

[1] From U. S. Naval Hospital, Chelsea, Mass.

was necessary for seven months. For the past few years he has been troubled by occasional cardiac pains and attacks of blindness, which have interfered with his work in a rubber-tire factory. The last seizure occurred two days before admission to the hospital, but, according to the patient's statement, it was of only momentary duration.

The positive findings on physical examination were of a rather indefinite nature—poor oral hygiene with dental abscesses, elevated blood pressure, and chronic tonsillitis. Any one of the above may give rise to curious and perhaps remote symptoms, none of which could be in any way considered as peculiar to any certain disease. Repeated urinalyses yielded a persistent albuminuria of from one to two plus, with a few leukocytes and many calcium oxalate crystals in practically every specimen examined, which, combined with a kidney function of only 30 per cent, established the necessity of considering renal damage. However, the origin of the urinary pathology remained still in doubt, but the anginoid attacks in a patient of his age favored the diagnosis of "essential hypertension" manifested by cardio-renal symptoms and signs.

His blood pressure, apparently, was not influenced by his activity, and he was not confined to bed, but his diet was of the low-protein, salt-restricted variety, which, with general measures, gave freedom from acute discomfort. His condition remained unchanged until July 30, on which date he had a chill with a high fever. In view of his having been in the Tropics this was not a surprising turn, and quinine was administered with relief resulting. The blood count at that time was: White blood cells, 3,750 per cubic millimeter; polymorphonuclears, 66 per cent; lymphocytes, 27 per cent; large mononuclears and transitionals, 6 per cent; eosinophiles, 1 per cent.

This was rather to be expected, since malaria causes a leukopenia practically invariably. However, the patient asserted his individuality by not conforming to the rules of conduct prescribed when a victim of such a condition, and maintained an almost constant elevation of temperature with persistent general malaise. On July 31 his blood was again examined with the astonishing result of a leukocyte count of only 1,450 cells per cubic millimeter; a red cell count of 3,070,000; and a hemoglobin estimation of 60 per cent. On August 3 red circumscribed areas appeared over the elbows and knees, and a blood count at this time was as follows: White blood cells, 1,325; polymorphonuclears, 11 per cent; small lymphocytes, 84 per cent; large mononuclears and transitionals, 5 per cent.

During these few days his complaints tended toward those of constitutional type with general malaise predominating, but on August 4 he developed sore gums, which were found to be infected with the organism of Vincent's angina.

On August 5 the blood showed: White blood cells, 1,000; polymorphonuclears, 12 per cent; lymphocytes, 68 per cent; large mononuclears and transitionals, 20 per cent.

The same findings were reported the following day, with the additional information that the Widal test was negative.

On August 9 his temperature returned to normal, and he felt considerable better. The blood findings were as follows:

White blood cells, 2,800; polymorphonuclears, 38 per cent; lymphocytes, 56 per cent; large mononuclears and transitionals, 6 per cent; blood platelets, 600,000.

On August 11 his condition was definitely improved, with the leukocytes numbering 8,200, and on the 15th he had a leukocytosis of 12,600, with the following differential count: Polymorphonuclears, 79 per cent; lymphocytes, 13 per cent; large mononuclears and transitionals, 7 per cent.

It is interesting to note also that his urine was negative from August 7 until discharge on August 28.

During the course of his illness, this patient presented a very baffling picture from the point of view of the findings in the blood and a culture was attempted with a negative result, with repeated Widal tests having a similar outcome. The affection of the gums, however, paralleled the abnormal laboratory findings, and the degree of the reduction in the number of white cells seemed to indicate the severity of involvement from the clinical standpoint, and vice versa. The fact that the Vincent's angina was responsible for the intense leukopenia was confirmed by the appearance of even a leukocytosis following energetic local treatment of the ulcerated oral mucous membrane. This demonstrates the fallacy of any precept which limits the occurence of a reduced number of leukocytes in the blood stream to a definite number of diseases. As further illustration of the variety of clinical manifestations accompanied by decreased leukocytes, it was found on consulting the records of all cases showing a count of less than 5,500 from January until September of 1925 in the naval hospital, Chelsea, that the list included secondary anemia, chronic appendicitis, varicose veins, acute bronchitis, arthritis, pernicious anemia, and a variety of purely local surgical conditions, which objectively did not seem to affect the individual constitutionally.

In general, it may be said that it is extremely rare for the leukocytes to number less than 3,000, but cases are on record which demonstrated a far lower count. Koblanck reported an epileptic, 25 years old, who showed only 1 white cell in 20 stained cover-glass preparations, and Cabot pointed out a remarkable incident in which a leukocytosis of 40,000 attendant on a lymphatic leukemia dropped to a hypoleukocytosis of only 419 as the result of the development of an acute sepsis.

As an element of confusion in considering the diagnostic value of leukopenia in disease, there is the lowered count classed as physiological, such as follows prolonged cold baths, short hot baths, and stimulation of sensory nerves. This phenomenon is due in a great measure to mechanical influence which results in an altered distribution caused by vasomotor action.

Related to the physiological phenomenon is the leukopenia resulting from diminished activity of the bone marrow, due to a low demand made upon it as is demonstrated in malnutrition and starvation. Lucci showed a decrease from 14,530 to 861 cells after seven days' fast. The number increased to 1,530 on the eighth day, where it remained throughout the concluding 22 days of his experiment.

In leukopenia with a pathological etiologic factor there are a few diseases, such as typhoid fever, tuberculosis, typhus, measles, German measles, mumps, malaria, influenza, glanders, and acute poliomyelitis, in which it is a constant laboratory finding. The importance of the leukopenia in connection with these diseases is not along diagnostic lines primarily, but its absence or the presence of a leukocytosis along with any one of them points to an additional feature, such as a complicating pyogenic infection, perforation in typhoid fever, or a mixed infection in tuberculosis.

In severe infections the cells are sometimes diminished, due to direct bone marrow injury, which does not permit its being able to functionate properly. This is seen following exposure to Röntgen ray and radium activity, due first to injury to the blood and then to the spleen and bone marrow. A like effect may be noticed accompanying chlorosis, pernicious anemia, and some severe secondary anemias.

In an experiment carried out by Bohland he found that the hypodermic injection of ergot, sulphonal, tannic acid, camphoric acid, atropine, agaricin, picrotoxin, delezene-peptone, diastase, and eel serum all caused a leukopenia to a marked degree.

The microscopical pathology directly responsible for this condition is relatively uncomplicated in that it merely shows a diminution in the hemopoietic areas in the bone marrow.

The blood picture as a whole shows a fall in the erythrocytes with a concomitant lessening of the blood platelets.

The latter augmentation may be sufficiently marked to cause purpura and a general hemorrhagic tendency with prolonged bleeding time and a weak clot out of proportion to the only slight increase in coagulation time. The red cells themselves, however, are normal in appearance in case the cause is not a primary blood disease such as pernicious anemia. The polymorphonuclear leukocytes become progressively less in number with usually a relative, but not an absolute,

increase in lymphocytes. Rarely are all varieties of cells affected equally, but an increase in any one of the types is not at all unusual. If disease be excluded, as may be the situation in the physiological production of this condition previously referred to, the polymorphonuclears furnish an index to the state of nutrition of the individual.

Finally, there is a disease entity termed idiopathic aplastic anemia whose etiology, as the name applies, is as yet obscure. The onset as a rule is insidious and is preceded by an indefinite malaise, but an elevation of temperature soon occurs which may cause the malady to simulate typhoid fever, especially if purpuric manifestations appear. The age incidence is in young adult life, with the outcome invariably fatal and running a course of a few weeks to a few months.

As a summary to the foregoing special attention should be called to the exceedingly rare blood count above described—leukocytes only 1,000 per cubic millimeter in number occurring with a Vincent's infection of the gums and tonsils. It should be also borne in mind that many diseases may cause a secondary aplastic anemia and individual variation plays an important rôle. But at the same time the presence of leukopenia is of distinct diagnostic value and its degree in the course of any disease is frequently an index to conditions not always clinically apparent.

DUODENAL ULCER [1]

A Study of 28 Cases

By J. N. C. Gordon, Lieutenant (Junior Grade), Medical Corps, United States Navy

This paper is a summary of conditions found in 28 cases of duodenal ulcer treated at the naval hospital, Chelsea, Mass., during the past 21 months—January 1, 1924, to September 30, 1925. An analysis of such a group was the direct result of one month's stay on ward 4-3 of this hospital and personal observation of seven cases of duodenal ulcer treated medically during this time. The remarkable manner in which these patients responded to treatment with almost immediate disappearance of their subjective symptoms at once suggested further study of similar cases.

By consulting the files in the record office, it was found that during this period 50 patients had been discharged with a diagnosis of duodenal ulcer. Of this number, however, 18 had negative X-ray findings, and for this reason could not be considered; 4 others were found to have had some other condition rather than duodenal ulcer. This left a total of 28 cases in which the X-ray findings disclosed ulcer of the duodenum. It is true that even positive fluoroscopic

[1] From U. S. Naval Hospital, Chelsea, Mass.

findings are not diagnostic in 100 per cent of such cases, but as only three of the entire series came to operation, X-ray reports proved to be the only basis from which to work.

Each case was considered with regard to the following points:

(1) Subjective symptoms.

(2) Physical findings.

(3) Laboratory findings.

(4) Progress under treatment and final disposition of the case.

These were considered thus:

1. *Subjective symptoms.*—(*a*) Pain (nature, location, time, and relation to meals and by what relieved).

(*b*) Belching.

(*c*) Dizziness.

(*d*) Vomiting (time, whether or not the vomitus contained blood, and if the act of vomiting relieved the pain).

2. *Physical findings.*—(*a*) Tenderness.

(*b*) Rigidity.

(*c*) Condition of the patient's teeth.

3. *Laboratory work.*—Gastric analyses, feces examination, red blood count, determination of hemoglobin, and barium series.

In addition, numerous other points were considered: History of loss of weight; history of blood in the stools; number of days spent in the hospital by each patient; type of patient—veteran or enlisted man; number of return cases, and the progress under treatment and final disposition of each case.

Unfortunately, complete laboratory work was not done on every patient. Gastric analyses and feces examinations were done in practically every case, but in only 9 of the 28 were red blood counts and hemoglobin determinations made. As regards symptoms, physical findings, progress under treatment, and final outcome of the case, complete and accurate records were uniformly found. The data collected were tabulated as shown in Table No. 1. A brief account of the facts determined follows.

The most common symptom was pain; it occurred in all but one of the cases, and in practically all of them was the chief complaint. Fourteen men complained of a "gnawing or burning" type of pain; 10 described a "dull, steady" pain; 4 complained of an "aching" pain; 5 had a "dull, aching" or "cramplike" pain. The most common seat of pain was in the epigastrium—in 20, or 71.5 per cent of the cases; 2 had a substernal pain; 1 complained of pain in the right hypochondrium; and 2 complained of pain in the left hypochondrium. Two patients had diffuse abdominal pain. In 11 men, the pain came on within one and one-half to three hours after meals; 3 stated their only pain was at night. In the remaining 14 patients, the exact relation of the pain to meals was

not stated. In 4, the pain was relieved by food or soda; food alone gave 3 relief; soda alone helped 4; 1 was relieved by food and vomiting; 3 by both soda and vomiting; and 2 by food, soda, or vomiting, while 10 gave no history of obtaining relief from their pain in any manner whatsoever.

The next most common complaint was belching of gas. This occurred in 19, or 67.8 per cent, of the cases. Belching was included in the chief complaint of many of these patients, who, when questioned as to their most prominent symptom, would reply in some such manner as this: " Pain in the pit of my stomach and belching gas." In four cases there was a history of belching a watery, sour, or " hot " fluid, but the remainder complained only of gas. The exact time at which belching occurred was not noted on enough of the charts to draw any definite conclusions regarding that point, but in the cases personally observed, the time was given as one-half hour to an hour after meals.

Nausea and vomiting occurred in 12 cases—a total of 42.8 per cent. Four of these 12 patients noticed blood in the vomitus at one time or another. Here again the time was not noted on most of the charts. However, it is interesting to note that only one of the four who complained of blood in the vomitus gave also a history of tarry stools. The other three either had no blood in their stools or did not notice it. In the one man who complained of tarry stools, feces examination was positive for occult blood; in the other three, it was negative. Another interesting point in regard to feces examination is that of five cases that complained of dizziness, three had stools which were positive for occult blood. It seems logical to assume that the dizziness in these cases was due to loss of blood, at least to a certain extent. Two patients complained of nausea without vomiting.

Of the 28, 16 complained of loss of weight and 9 of loss of appetite. The actual number of pounds lost varied from 5 to 10 pounds to as much as 30 pounds over a period of one year. The men, when questioned as to the loss of appetite, would say that they felt hungry up to the time that they sat down to a meal, and then all desire for food would leave them. This occurred in only about one-third of the cases; the remainder did not complain of loss of appetite, and, indeed, in eight cases, food relieved the patient's pain. Of the nine who complained of loss of appetite, only six also complained of losing weight. It is unreasonable to suppose that a man who lost his appetite would fail to lose weight, but of course such a thing is entirely possible in a man who would force himself to eat, whether or not his appetite was good.

Now that the subjective symptoms have been discussed, let us consider the physical findings in these cases. The most essential

points gone into for the purposes of this paper were the presence or absence of tenderness and rigidity, and the condition of the teeth. The teeth were considered as a possible focus of infection, and an effort was made to determine the exact number of these cases that had rotten teeth. In connection with foci of infection, as a possible etiological factor, note was also made of the number of cases that had a chronic appendicitis. Of the 28 cases, there were four who were diagnosed as having chronic appendicitis along with their duodenal ulcer. As regards the teeth, 15 had poor teeth, 7 had teeth in fair condition, and 6 had good teeth.

Tenderness occurred in 16, or 57 per cent of these cases, and rigidity was found in 4. The tenderness in 11 of the 16 was in the epigastrium; 1 had tenderness in the right hypochondrium; 1 had umbilical tenderness; 1, tenderness over the gall-bladder area; 1, substernal tenderness; and 1 man had diffuse tenderness over his whole abdomen. Rigidity in one case was found over the upper right quadrant; in the other three it was in the epigastric region.

Considered under laboratory work were: The number of cases that showed an increase in the total acidity and free hydrochloric acid; likewise the number that showed a decrease in the above; the red blood count, in order to determine the number of cases showing anemia; and feces examination, the results of which have already been considered.

The total acidity was found to be increased in 17 of the 19 cases in which gastric analyses were recorded, the highest figure being 142 and the average 85–90. In two cases the total acidity was normal; in none was it decreased. These findings certainly tend to show that most cases of duodenal ulcer have an accompanying hyperchlorhydria. The free hydrochloric acid also showed an increase in 12 cases; the highest figure was 88 and the average 63. Thus in 19 patients whose gastric contents were examined hyperchlorhydria was found in 17, or 89.5 per cent. In none was there a decrease in the total acidity, but two showed a slight decrease in the free hydrochloric acid.

Anemia occurred in only one of the nine cases in which blood counts were made; this is 3.6 per cent of the entire series. Routine blood examinations are not run on the ward, and, except in cases with a fever, a definite pallor, or some other thing suggesting blood work, it was not done. Had blood work been ordered in all of the cases, some definite conclusions might be drawn; even so, three cases in which no anemia was found show that a decrease in the red blood cells does not necessarily accompany every case of duodenal ulcer. In the single positive case the red blood cells numbered 4,220,000 and the hemoglobin was 65 per cent.

Only cases in which barium series showed a definite defect in the duodenal cap were considered. The fluoroscope was used in these cases rather than successive X-ray plates. As previously mentioned, such findings are not absolutely diagnostic, but they may certainly be depended upon in at least 95 per cent of the cases when done by a competent roentgenologist. In three cases which were operated upon the findings at operation bore out the X-ray reports on these patients.

Next to be considered are the treatment and the progress under treatment of the patients. The principles of treatment were: (*a*) Rest in bed, (*b*) clearing up of foci of infection, (*c*) diet regulation and alkalization of the stomach contents to lessen irritation—in short, the Sippy method. Every case on entering the hospital was put on the Sippy diet and Sippy powders, and kept in bed at least two weeks. It is not necessary to go into the details of a so generally accepted method of treatment in a paper of this sort. Only three cases failed to improve under medical treatment and came to operation. A posterior gastroenterostomy was done in each case. Of the three, two recovered with good functional results and one died.

The remaining 25 cases, or 89.5 per cent of the total number, showed marked improvement under medical treatment. Not one failed to be relieved of his pain almost at once; ten gained in weight while on the Sippy diet, and every one was discharged completely free from his subjective symptoms. The way in which the pain cleared up was astonishing; in some cases it was gone in 24 hours, and in a great majority of the patients it had disappeared in three days at the longest. Likewise the belching, vomiting, and dizziness were gone in a few days. Patients who came in complaining of lack of appetite were, within a week, wanting some "real food"; others "forgot they even had a stomach" in a few days' time. The tenderness usually persisted for a week or so, but in every case was eventually relieved. After being kept in bed two weeks, the patients were usually in condition to be let up, and two or three weeks later were ready for discharge. The average number of days spent in the hospital by the medically treated cases was 42. (The two who were operated upon were discharged on the forty-fifth and eighty-ninth days of their stay in the hospital.) When discharged, each patient was advised as to diet and the continuation of his treatment at home, and to date there have been no return cases.

Of the cases considered, all but two were Veterans' Bureau patients, and that fact accounts for the length of time spent in the hospital. Except for this, practically all of them could have been discharged at the end of three weeks. Of the cases seen personally, five of the seven were ready for discharge in three weeks. Another factor which had a bearing on the period of hospitalization was

the presence of some other chronic disease which it was necessary to treat at the same time as the gastro-intestinal condition.

A paper has recently been published by Dr. F. L. Snyder, of Ann Arbor, Michigan, dealing with the symptoms and clinical findings of duodenal ulcer.[1] His series consisted of 50 cases, all of which were operated upon. In this series, the most common symptom was pain in the epigastrium, which occurred in 84 per cent, as compared with 71 per cent of our group. The pain came on two to four hours after eating in 70 per cent as compared with 38.2 per cent here. Tenderness in the epigastrium, which was found in only 57 per cent of our cases, he found in 86 per cent. He also found that soda was the thing which most often gave this type of case relief.

TABLE No. 1.—*Total number of cases—28*

	Number of cases	Percent
Pain	27	96.5
Gnawing	14	50.0
Dull	10	35.7
Aching	4	14.3
Epigastric	20	71.2
Substernal	2	7.1
Right hypochondriac	1	3.6
Left hypochondriac	2	7.1
Diffuse abdominal	2	7.1
Relieved by:		
Food	8	28.5
Soda	11	39.7
Vomiting	7	25.4
Belching	19	67.8
Nausea and vomiting	12	42.8
Nausea without vomiting	2	7.1
Blood in vomitus	4	14.3
Dizziness	5	17.8
Loss of appetite	9	32.1
Loss of weight	16	57.1
Number who gained weight while in hospital	10	35.7
Number who lost weight while in hospital	7	25.0
No change in weight	11	39.7
Tenderness	16	57.1
Rigidity	4	14.3
Teeth:		
Poor	15	53.5
Fair	7	25.0
Good	6	21.0
Gastric analyses	19	
Increased total acidity	17	60.9
Normal total acidity	2	7.1
Increased free hydrochloric acid	12	42.8
Normal free hydrochloric acid	5	17.8
Decreased free hydrochloric acid	2	7.1
Red blood counts	9	
Anemia	1	3.5
History of blood in stools	4	14.3
Blood in stools	4	14.3
Constipation	14	50.0

CONCLUSIONS

1. The most common symptom of duodenal ulcer is pain in the epigastrium coming on one and one-half to three hours after meals.

2. Tenderness in the epigastric region is the most prominent objective symptom.

[1] Mich. State Med. Soc. Journal, Aug. 1925, p. 419.

3. Hyperchlorhydria is practically a universal accompaniment of duodenal ulcer.

4. Anemia is rather an uncommon finding in such cases.

5. A great majority of patients with duodenal ulcer show rapid, marked improvement under medical treatment with complete disappearance of their subjective symptoms in two to three weeks.

EXTRAGENITAL CHANCRE

WITH REPORT OF CASE[1]

By R. F. HAGUE, Lieutenant (junior grade), Medical Corps, United States Navy

This case is reported with a view to emphasizing the importance of early diagnosis in any case of a nonhealing lesion on the body. This becomes all the more important if the patient is an enlisted man of the Navy, because of the great danger of spreading the disease from which the patient suffers to other members of the service who might innocently contract the infection and yet suffer under article 1196, of United States Navy Regulations, 1920. (Loss of pay, etc.)

The patient, L. A. H., electrician's mate, 3d class, United States Navy, was admitted to this hospital September 13, 1925, with a nonhealing ulceration on the dorsal surface of the fourth finger of the left hand near the metacarpo-phalangeal joint. Five or six weeks prior to his entrance to the hospital, the patient developed a small lesion on his finger and, at that time, a definite history of infection was sought but was not obtained. The patient ascribed the lesion to an injury from a ring which he was wearing. He was treated locally with ammoniated mercury ointment for a considerable time, but the lesion gradually became more inflamed and larger, until, after about six weeks, a secondary rash appeared on the trunk, arms, and legs and he was sent to this hospital for diagnosis. Here the patient gave a history of a possible venereal infection having occurred in July, 1925, in Seattle, but he had not been exposed since. He first noticed the lesion on August 10, about 25 days after exposure, but claimed that he injured his hand on his ring on August 5, 1925. The lesion gradually became larger, and in an effort to stimulate granulation tissue the ship's doctor applied balsam of Peru with little result, if any. Ammoniated mercury was then tried and no results obtained.

Physical examination was negative except for a rash over the entire trunk of the body, arms, legs, and near the occipital region of the scalp. This eruption consisted of a generalized maculo-

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[1] From U. S. Naval Hospital, Chelsea, Mass.

papular eruption of copper color, discrete and nonpruritic. Little difficulty was experienced in arriving at the proper diagnosis. The lesion on the finger was about the size of a dime, somewhat angry looking, raw at its base, had a regular border which was eroded, a serous discharge, and was somewhat painful. The interesting feature about the patient was that his whole left arm was considerably swollen, as were the fourth and fifth fingers of the left hand. Glandular enlargement, which the patient states came on about two weeks after the lesion appeared, could be readily palpated in the epitrochlear region and in the axilla. This should have given a clue to the nature of the infection weeks ago had it been looked for.

A dark-field examination was made on the day of admission and the lesion was found to be loaded with the *Treponema pallidum*. On September 4, a blood Wassermann test was made and found to be 2+. There was no doubt that this was a case of syphilis and that the lesion on the finger was the primary sore or chancre. The diagnosis, while being confirmed by the laboratory, should have been made without any difficulties, considering all the facts in the case together with the physical findings before the secondary eruption appeared. The patient received 0.6 gram of neoarsphenamine on September 14, with litle reaction; and 2 days later 0.45 gram of old arsphenamine or salvarsan was injected. Photographs of the lesion taken the day after admission and a week later, after two injections of salvarsan are submitted to show the rapid healing of the ulcerated lesion. (Figures 1 and 2.) The secondary rash disappeared in five days after treatment began.

It might be well in connection with this case to discuss the differential diagnosis of chancre. As a rule, the infections occur where there is a direct contact between an abraded surface and the infective organism. A small break in the epithelium, that might well be microscopical, is sufficient for the entrance of the organism. Soon a red macule appears, which is generally symptomless. It is often not noted unless especially looked for. It gradually becomes larger and harder, then becomes a raised papule, and soon its surface becomes eroded. A week or 10 days later, the patient has a typical chancre. Pain is, as a rule, not present. If all chancres were as typical as the above outlined, there would be but little difficulty in their diagnosis but, unfortunately, they are not. The majority of chancres are typical, but many are atypical. A number of them start to develop and then retrogress, and the patient may only remember having had a pimple, or may not remember having had a lesion of any sort.

In women there is a large area which may be infected and lesions are so easily concealed that they are often not noticed by the pa-

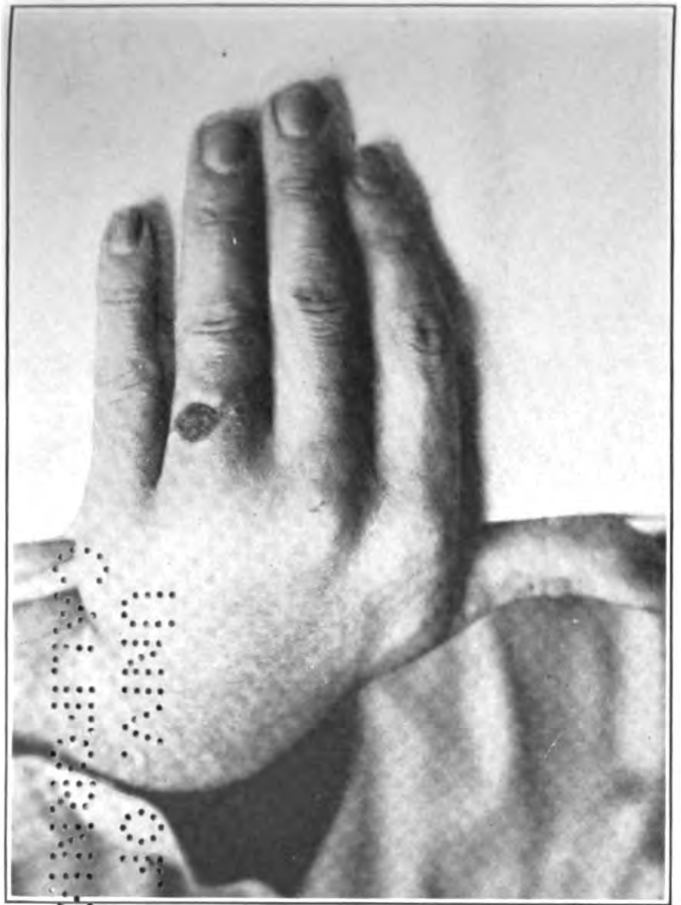

FIG. 1.—APPEARANCE ON ADMISSION, SEPTEMBER 13, 1925

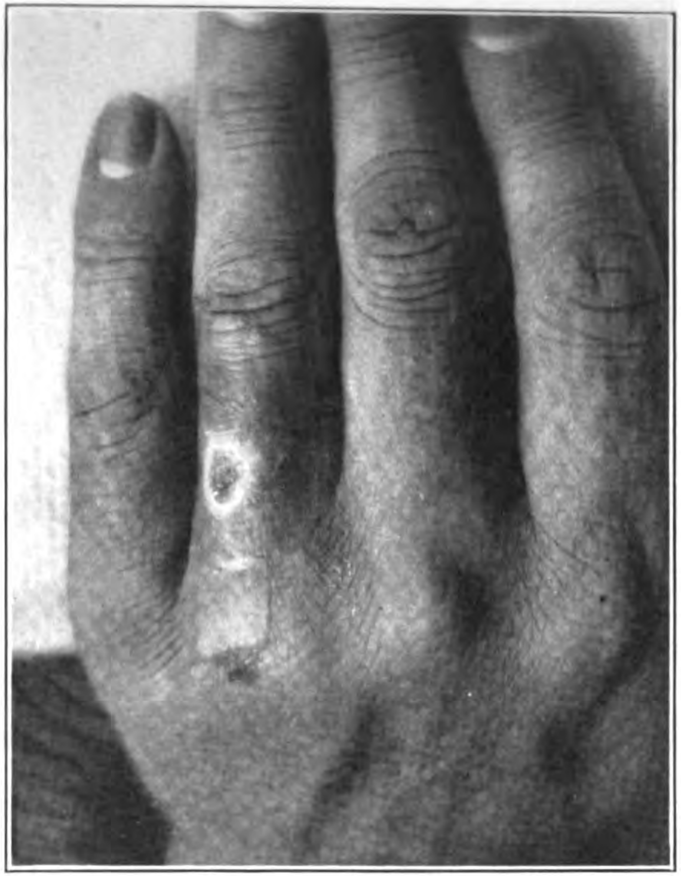

FIG. 2.—APPEARANCE TWO WEEKS LATER, AFTER TWO INJECTIONS OF SALVARSAN

tient or even by the examiner. Even in the explosive stage it is exceptional to find the primary lesions in women. It should be remembered, however, that in no form of syphilis, except that acquired by transfusion, is the disease contracted or acquired without a primary chancre, although one may not be able to find it.

The true chancre always presents certain definite characteristic diagnostic points:

(1) As a rule the lesion looks harmless.

(2) It is seldom painful.

(3) It is usually single, although it may be multiple, but these cases are rare.

(4) It has a regular eroded border.

(5) The base is hard and indurated, and feels like a foreign body in the skin.

(6) The discharge is serous or serosanguineous in nature.

(7) There is a polyglandular, nonsuppurative, inevitable adenitis.

(8) The incubation period is from 4 to 28 days to 3 months.

(9) In the untreated chancre one can demonstrate the presence of the *Treponema pallidum*, and often in those that have been treated for some time with mercury, as in this case.

The chancre must be differentiated from chancroid and squamous cell carcinoma of the penis. In chancroid, which is a local infection, there is usually no constitutional disorder but the lesion looks more serious, is much more painful, and is multiple as a rule, very autoinoculable and has an irregular, undermined border and a purulent discharge. It is also associated with a monoglandular, suppurative, noninevitable adenitis. In women both labia are involved. It has an incubation period of a much shorter duration than the chancre, that is, two to seven days. The organism responsible for this condition is the *Streptobacillus of Ducrey*. Any case of chancroidal infection should always be regarded as potentially syphilitic, because of the common source and because they may both exist at the same time, the chancre being completely overshadowed by the chancroidal infection.

So far as the squamous cell carcinoma of the penis is concerned, it may be differentiated from the chancre by the hardness and infiltration of the tissue surrounding. When touched or manipulated, it bleeds freely and, as a rule, has a bloody discharge. It has an everted, irregular border which appears translucent or pearly. A late adenitis is associated, while in chancre we find an early adenitis.

When the chancre appears extragenitally, the differential diagnosis becomes somewhat more complex and difficult. In the first place, one seldom associates such a lesion with a venereal infection, and, in the second place, there are many other conditions that resemble chancre in more than one way and render the diagnosis more difficult. Often a primary lesion is not thought of at all, and the patient is treated for every known condition except for the one for

which he actually needs treating. It should be borne in mind, however, that the chancre of the extragenital type is not different from the one that occurs on the genitals and there should be no great difficulty in diagnosing such a condition. Any suspicious lesion of a few weeks' duration, with enlargement of the nearest anatomically connected lymphatic glands, which appear hard and shotty, is almost invariably found to be a chancre.

Any nonhealing lesion or ulceration should be diligently studied and the various possibilities ruled out. The most important diseases to be differentiated here are: (*a*) Chancre, (*b*) chancroid, (*c*) epithelioma, (*d*) lupus vulgaris, (*e*) malignant pustules, (*f*) blastomycosis, (*g*) actinomycosis.

The chancroid have been discussed above, also the chancre. While pain often gives a clue as to the nature of the infection, it should be remembered that pain is often associated with a chancre when it occurs extragenitally, particularly is this true of a chancre of the finger.

The epithelioma or rodent ulcer may well simulate a chancre. The superficial epithelioma can often be ruled out by the age of the patient. It occurs generally in later life and is a very slow growing process. It is usually single. The picture presented by the epithelioma is quite definite. It is roundish, with sharply defined, flat or raised pearly edges, quite indurated. The base is hard, reddish, and uneven. It is easily disposed to bleed on the slightest manipulation, and there may be a scanty yellowish secretion. There is no involvment of the lymphatic glands in the superficial type, and pain is usually only slight. There is an absence of constitutional symptoms.

The deep-seated epithelioma, however, may be somewhat more difficult to rule out. This ulcer develops from the superficial epithelioma. The ulcer itself does not differ materially from the superficial variety, except that it is much deeper, very firm, and heavily infiltrated. It is much more malignant and quite painful. It is here that we get an involvement of the lymphatic glands, and this often proves a stumbling block to the inexperienced dermatologist. The lesion looks much more serious than the chancre, and the patient often shows the seriousness of the malady and slowly succumbs through marasmus, hemorrhage, or exhaustion. The history, of course, is that the lesion has been of long standing, and has been very slow in its progress.

Lupus vulgaris may sometimes simulate a chancre, but can be ruled out with little difficulty. In this condition patches develop, brownish or reddish in color, which consist of papules and nodules and flat infiltrations. These patches usually terminate in ulcera-

tion and scarring. Lupus is not a difficult disease to diagnose, because it presents certain definite characteristics which are found only in lupus. The disease begins as pin-point to pin-head sized, grouped or disseminated, flat papules. These develop into pea-sized or larger tubercles and nodules, which later ulcerate. This disease is very chronic and may not ulcerate for some time, and one always gets a history of extreme chronicity. The "apple-jelly" nodules in the ulceration, which are nothing more than the brownish recurrent tubercles, are very characteristic of lupus and occur only in that disease. Lupus occurs most frequently upon the face, particularly on the nose, cheeks, and ears. Occasionally it occurs upon the extremities and trunk. As a rule, lupus develops before the age of puberty and its course is slow and insidious. If we were to go far into the history we would invariably find a scrofulous hereditary tendency. Further, there may be some concomitant signs of a tuberculous diathesis.

The ulcers of lupus can be differentiated easily from the lesion of chancre. The former are rather superficial, with irregular, undermined edges. There is but a slight discharge. The crusts in lupus are scant and reddish brown. The lesions are multiple in lupus, while in chancre there is but one, as a rule. In lupus, new lesions can be seen to develop in the old scar tissue.

Malignant pustule or anthrax may simulate chancre where the pustule occurs singly. The pustule is produced by the *Bacillus anthracis* and is characterized by a gangrenous, nodular cutaneous lesion. However, the disease is attended by severe constitutional disturbances, rapid in its course, and may terminate fatally in three days—in fact, it is fatal in 33 per cent of cases. The lesion itself may be ruled out with little difficulty. It begins generally as a hemorrhagic bulla or pustule. Underneath this is a gangrenous eschar with a dusky red infiltrated areola, around which the skin is edematous and infiltrated. Here, also, we find a marked involvement of the lymphatic glands. Of course, the history of occupation, the rapid course of the disease with its severity should make it easy to differentiate malignant pustule from chancre.

Blastomycosis may sometimes simulate chancre, particularly as the site of blastomycosis is most frequently on the internal aspect of the legs and on the fingers and hands, sites on which the extragenital chancre occurs frequently. Its course, however, is quite chronic. Microscopic examination of the pus from the minute abscesses should readily reveal the organisms.

Actinomycosis may also in some instances resemble chancre. It is due to the ray fungus and is characterized by deep subcutaneous tumors, which break down and suppurate. The diagnosis here is readily made, for the fungus is easily found if present. This disease

has a predilection for the face and neck. The ulcer discharges a bloody serous fluid and pus containing the characteristic yellow sulpho-granules. When these are examined they are seen to be made up of the ray fungus. There is always a tendency to sinus formation. The ulcers have uneven and nodular edges. The disease is very insidious in its onset and has a slow, chronic course.

Where the diagnosis of chancre is uncertain, a dark-field examination and a blood Wassermann test should be made. If either of the two is positive, many of the above conditions could probably be ruled out or differentiated earlier in the case. Dark-field examination should be advocated in any similar case, where there is an involvement of the lymphatic glands. It is, of course, possible that a mixed infection may occur and that a chancre and chancroid may occur together. The chancroidal lesion may mask the chancre, but a careful examination and a dark-field examination for the organism should be made to rule out such a possibility.

The question of the source of infection in the case reported is interesting, particularly since this man's condition is a beautiful example of the high degree of possibility existing for spreading such an infection, he having carried an open lesion, loaded with spirochetes for six weeks before a diagnosis was made. In this six weeks' period, the patient had been on duty regularly, among his fellow men, handling the same utensils and tools. Can any amount of speculation say just how much of this dreaded disease he has passed on in that time? Might a similar overlooked and undiagnosed case not be the source of his infection?

To avoid transference of the disease to others, it is important that we keep in mind the possibilities of primary infection in any site, make an early diagnosis, and, if a diagnosis of primary lesion be made, isolate the patient and protect others, and institute intensive luetic treatment.

A CASE OF ALVEOLAR ABSCESS WITH UNUSUAL SYMPTOMATIC MANIFESTATIONS

By E. D. Harrison, Pharmacist, United States Navy

The following account of an alveolar abscess of unusual severity is offered on the strength of a possibility that it might be of some interest to the medical and dental professions.

The writer, the medical department's representative at an isolated Alaskan radio station, was called to attend W. P. S., chief radioman, United States Navy, early in the morning of October 28, 1925. S. stated that he had not been feeling well for several days. He complained of having had chills during the night followed by intense headache and general malaise. He had no appetite and even

the thought of food was repulsive. Temperature was 101.2 degrees Fahrenheit; his pulse was 90; respiration was normal.

The patient, a stockily built man of 170 pounds, presented the appearance of a well-nourished adult. Age, 36 years; married and the father of one child aged 14 years. Examination of the ears was negative. The mouth showed 30 teeth present. Two had gold crowns, several others had been repaired, but all were in apparent good condition. Tonsils were negative. There was no pain in the chest or back, and, so far as the writer could determine, examination of the heart and chest was negative.

The abdomen was soft and presented no symptoms. However, there was a history of chronic constipation and S. had not had a good bowel movement for two days. The bladder and genitals offered no suggestion as to the cause of the trouble. The urine was negative for sugar and albumin. No blood count was taken as there was no apparatus available for this purpose. The patient, a native of Texas with 15 years' continuous naval service, gave no history of malaria. There was no cough, running at the nose, nor any other signs of a cold. A careful examination failed satisfactorily to account for the temperature and violent headache.

At 10 a. m. the patient had another chill. The symptoms were treated as they presented themselves. Ten grains of aspirin were given for the headache. Calomel, to the extent of three grains, was administered in broken doses during a period of three hours. This was followed by Epsom salts. The temperature at 3 p. m. was 103.6. The headache grew gradually worse in spite of palliative measures. The pulse was 100; respiration was normal and continued so throughout the illness. The patient was very restless. At 6 p. m., there having been no action from the cathartics, a low enema was administered. At 8 p. m. the temperature and headache were unabated.

During the night S. got little rest. His bowels moved freely as a result of the cathartics. The temperature dropped to slightly above 100. The headache was still present but not so severe as on the previous afternoon. The patient noticed tenderness at the base of the two upper central incisors upon occlusion. Both of these teeth had been repaired in 1908. One was filled, the other crowned. The uncrowned tooth presented the darkened appearance of a tooth in which the nerve is dead.

During the second day the patient was exceedingly restless. The headache returned and was as severe as before in spite of 7½ grains of aspirin every four hours and such other therapeutic measures as were possible. During the afternoon some nose bleeding occurred. The temperature mounted steadily until it reached 104° F. at 7 p. m. At this time a contract surgeon of the United States Public Health Service was reached by telephone. The symptons and treatment

were carefully explained to him. He stated that the case sounded like influenza and approved the treatment.

The patient spent a sleepless night, and on the third morning complained of agonizing pain at the base of the two upper central incisors. His temperature was 101° F. and pulse was 100. The Public Health Surgeon was brought to the station by special railroad conveyance, arriving at 9 a. m. After a careful examination he was of the opinion that the teeth in question were causing the trouble and recommended immediate dental attention. The patient was conveyed to town and placed in the dental chair. Both teeth were extracted, pus welling from the sockets immediately upon their removal. The sockets continued to drain pus for several minutes. They were thoroughly cleansed and packed with cotton pledgets moistened with tincture of iodine. The patient walked from the office feeling "much better."

The man's temperature at 6 p. m. that day was 102.2°. The headache was gone. The tooth sockets were cleansed daily with a weak solution of phenol. His temperature reached normal on November 1. His appetite began to pick up and he was discharged to duty well November 5, 1925.

Remarks

This case is believed to be unusual because of its symptomatic manifestations. The patient was seriously ill with an alveolar abscess for two days before the focus of infection became sufficiently apparent to lead to any definite conclusions. The onset with chills and headache resembled that of pneumonia. The symptoms present made one almost positive at first that the case was influenza in one of its various forms. If the patient had had a recent history of malarial infection, the diagnosis of malaria might have been made on snap judgment. The rising and falling temperature, nose bleed, and influenza-like onset is suggestive of one type of typhoid fever. On the other hand, constipation sometimes causes all the symptoms noticed at the time of admission to the sick list.

NOTES AND COMMENTS

RESEARCH IN THE MEDICAL SERVICES

That medical research does not require elaborately equipped laboratories, exceptional training, nor an especially gifted medical man for its accomplishment is shown by Lieutenant General Sir William B. Leishman, Director General of the Army Medical Service of Great Britain, in an interesting paper on "Research in the Medical Services," published in The Lancet (II; XVI; October 17, 1925). As might be expected from the author's close association with the Army, his remarks deal chiefly with that branch of the service. They apply, however, with equal force to the Navy and are as true for the American Navy as they are for the same branch of the British service.

Sir William Leishman, because of his outstanding success as a research worker, is well qualified to advise others, and his words should carry great weight.

The author's definition of "research" is not the narrow one usually given to the word, which limits it to "experimental inquiry," but is a much broader and more just one. He considers research to "cover any means by which we, of set purpose and on a deliberate plan, strive to add to the existing knowledge of the cause, the prevention, and the treatment of disease."

The difference between routine work, no matter how well done, and that which is new and of varied interest is noted. Anything in the nature of research belongs to the latter category.

Speaking of the advantages of the service, the author says:

"Let us now look for a moment at the very exceptional facilities and opportunities which we of the service possess; they are indubitable and, I believe, far greater than those enjoyed by the great majority of our confrères in civil life. First, and most important, our material. Whether sailors, soldiers, or airmen, those of whom we have the honor to be in medical charge become, if we wish, our friends and comrades throughout their service; where they go we go, and their health and physical well-being is not only our charge but is to us an open book throughout their service, wherein we may read, and perhaps even write, as we will. From their examination as recruits till they leave the colors their physical standards and their medical history are recorded, and they are under our daily supervision. What would not our civil brethren often give for such an intimate knowledge of the past history of a patient! There is

nothing like it, except perhaps in some schools and institutions and in relation to some of the notifiable diseases, such as tuberculosis. The fact that the men, like ourselves, are subject to discipline brings in another element of great value, inasmuch as it renders possible such things as systematic or periodical examinations and the employment of uniform standards of procedure, which are, as a rule, totally impracticable elsewhere."

As to the statement, so often heard, that opportunities in the services are meager, that we see only the commoner diseases of young manhood, and that most of our work consists in treating venereal diseases, the author tells us that this was not true when he entered the service in 1887 and is even farther from the truth at the present. The advantages of the service are summed upon in these words: "Medical and surgical material, then, is abundant and varied, both at home and abroad, and we are most favorably placed to observe our cases from start to finish and, if we wish, to follow them up afterwards."

The author states of the British services, and the same applies in no less degree to our own, that they have been able to equip and maintain laboratories and hospitals in accordance with the most modern requirements. Whenever special tests are required, specialists are available to perform them, if not on the spot, at least within easily reachable distance. Thus we are able "to investigate fully all our cases, to observe their progress accurately, and to make permanent records in relation to any facts of importance. These are great assets for any medical man, and, if we do not benefit by them to the full, the fault is our own."

Attention is called to the fact that, in the past, the services have a record of research of which they may well be proud and that, while much of this work was carried on by men who were specially trained or who enjoyed special facilities, much of the most valuable research was done by men with no special training who had to rely solely upon themselves and create their own opportunities. This, too, was done in a day when specialists were rare and well-equipped laboratories were few.

Those who have been in the service long enough to have acquired a wide experience of men and foreign lands and who yet are young enough to retain energy and ambition are in a position to receive the greatest good from the many post-graduate courses available. Whether or not we wish to pursue some special work to great length, we can at least bring and keep ourselves up to date in our profession.

The author says: "The point which I now wish to make is this. In my view, everyone who has reached this stage in his service career is well equipped to make valuable original observations on many lines of professional work, either alone or with the readily available help

of his specialist comrades * * *" However, the author reminds us, many of the men younger in service are also able to make original observations of value. Many of these hesitate to put their observations in writing because of the fear that they might not be novel or for other reasons.

The value of research work to the individual, aside from its value in advancing our profession, is enormous. It makes professional life more interesting. There is always the chance that something of great importance might be brought to light and that the investigator's name would forever be associated with the observation, thus bringing him enduring fame. As a warning, the author calls attention to the two essential qualities which the research worker must possess in order to have any chance for success—patience and absolute honesty. "One needs really something of the qualifications of the fly-fisher, for whom there is such hope in every cast that it will carry him happily through a blank day, leaving him with cheerful anticipations of the morrow."

Another word of counsel given by the author is to the effect that much good work fails to obtain acceptance and credit for lack of record of some observation or test which might be considered by critics as essential to the acceptance of the conclusions. Collaboration with a specialist colleague, in such a case, is desirable.

How may one decide upon the subject to be investigated? How may the material at hand best be utilized? These questions are answered by the author who tells us that, if he were a young officer who had not before attempted anything of the kind, he would begin by asking himself the question, "In what line of professional work am I most interested and would most wish to become expert?" There could be no doubt about the answer in each individual case. He would then think over the many branches of the subject selected, finally picking one or two for closer scrutiny. He would think over the cases which, in his own experience, had puzzled him and in which he had not been satisfied with the generally accepted explanation of their etiology or in which the treatment in common use had not proved satisfactory. He would then proceed to "soak himself" in the literature of the subject. Soon one would find that others had met with the same difficulties. The new conclusions and viewpoints of these would be stimulating. It would not be long before one became critical of conclusions and began to ask one's self. "Why does this fail to convince me?" or "How am I to reconcile this result with what has been recorded by X, Y, or Z?" After this, one would begin to thing, "Would it not be possible to settle the point if I were to do—what?" When this point is reached, it is time to start the work and the campaign must be planned. We are told, "It is impossible to take too much trouble over this planning of

the inquiry, for, if every fallacy is not thought of beforehand, and guarded against so far as possible, one may waste much effort and have to start afresh."

"Unexpected difficulites, failures, interruptions, are the daily bread of the inquirer, but, if met with cheerful philosophy, and still more if one is wise enough to have prepared more than one string for one's experimental bow, one may confidently anticipate reaching a result worth communicating to a society or journal and will have achieved an altogether new outlook on professional work and acquired that admirable thing, a new interest in life."

The fields for research are numerous and no one need experience difficulty in finding some line of work to suit his taste. As the author tells us "* * * The tropical diseases are bristling with unsolved problems of aetiology, of treatment, and of prevention, and our opportunities in this line when on foreign service are unbounded. The Navy and the Air Force have, I take it, no lack of unsolved problems special to themselves, while in the Army there are a host of morbid conditions, some of them of first-grade military importance, in which our special facilities should give us a better chance of adding fresh knowledge or of clearing up difficulties than falls to the lot of most of our brethren. Again, to the considerable number of us to whom preventive medicine makes a stronger appeal than clinical work, the difficulty will be to choose one out of the hosts of problems which are presented to us by the rapid development of this subject."

Sir William Leishman calls attention to a form of research work which has not been extensively used in the services. This is "collective research." The organization of the services is especially well adapted to this form of research and advantage should be taken of it. By "collective research" is meant the investigation of a selected problem by a number of workers in different places who follow an agreed plan and conform to rigid standards as to the material and methods to be employed.

In the British Army Medical Service there are Directorates of Pathology and Hygiene. These directorates discuss subjects suitable for "collective research" and formulate the plans for carrying out the work. Some of the subjects which have been chosen are: Influenza, latent sepsis, catarrh, typing of strains of diphtheria, cholera, and dysentery bacilli; the Schick reaction, parallel testing of the Sigma and Wassermann reactions, and sand-fly fever.

"Exigencies of the service" frequently interfere with the completion of the work but this is no reason for abandoning it or not attempting it.

The author closes his paper with these words: "To conclude, I have been urging upon you that we should endeavor to secure a

larger output of medical research from the services, and have suggested that this is well within the power of many who have not so far embarked on it. I have done so for the following reasons: First, because it is our bounden duty to leave nothing undone which we can do to maintain or improve the health of the fighting forces, and to anticipate and prevent medical catastrophes in the future, not only by utilizing new knowledge, but by adding to it. Second, because I know nothing better calculated to maintain a man's professional interests as well as to keep him out of the groove which may become so dangerously deep as our service advances. Finally, it is only by contributing our full share to medical progress that we can hope to maintain the high prestige gained for our respective services by those who have gone before us."

In our own Navy abundant opportunity to carry on research work, either singly or collectively, is always at hand. Even on board our fighting ships there are many problems of hygiene, sanitation, and preparation for war which have not been solved satisfactorily. In our tropical possessions we have unlimited material available for a thorough study of most of the diseases peculiar to the warm countries. Our hospitals are filled with interesting cases which we may study as we will. Even our recruiting stations and navy yard dispensaries offer opportunities for useful research along many lines. In the BULLETIN we have a medium through which we may present our suggestions and conclusions to readers who are certain to be interested in and sympathetic toward our efforts. If we fail to take advantage of our great opportunity, we are not only missing something which will give us new interest and pride in our service but are derelict in our duty as well.

PERIODIC HEALTH EXAMINATIONS

Southwestern Medicine (September 11, 1925) contains a paper by G. S. Luckett, M. D., director New Mexico State Bureau of Public Health, on "Life Extension." Much has been written upon this subject in recent years and much more will be written as time goes on, because life extension is a subject in which everyone is vitally interested. Doctor Luckett presents the subject in a simple and clear manner and brings up some points not always considered by other writers. The following is an abstract of his paper:

"The medical profession deserves great credit for having been instrumental in increasing the average expectancy of life almost five years in the decade 1910–1920. Sight must not be lost of the fact, however, that most of this increase has been due to a reduction in the death rate among infants rather than to an actual deferring of

death among adults until a later age. Increased knowledge in preventing the spread of contagious diseases and more rational treatment of these diseases when they do occur have been effective in a large measure. Better care of infants has also brought results. All of this is commendable, but if really worth-while results are to be obtained, some means must be found to prevent, if possible, or, if not possible to prevent, to discover in their earliest stages those diseases which still remain the leading causes of death among adults. These diseases are organic heart disease, chronic nephritis, cerebral hemorrhage, cancer, and tuberculosis. As is seen, these can not be controlled by the same methods that have been so successful in combatting mortality in infancy and childhood, namely, public-health measures such as quarantine, vaccination, etc. What then remains? Only the early detection of the condition at a stage when corrective measures stand a fair chance of being effective. How may this be accomplished? Only by complete physical examinations at definite intervals. The periodic physical examination of apparently normal individuals is no new thing but is just now beginning to receive the attention from the public it deserves. Various agencies, national and local, should be and are directing much thought to this work. Unfortunately, not all physicians are prepared to conduct such a complete examination—unless it be complete it is valueless. Consequently much of this work has fallen to organizations which have been developed with the commercial spirit uppermost. The work should not be left in the hands of these organizations, because they can not have that intimate personal knowledge of the patient which is so essential to a proper evaluation of the findings and as a guide to the directions which are to be given the individual in order that he may profit most by the examination. Only the personal physician is in possession of all the facts, and he is the one who should conduct the examination. It is extremely important that every physician should be able to conduct such an examination intelligently and thoroughly. This can be accomplished only by hard study."

Officers of the Navy are fortunate in that they are required to have a periodic health examination once a year and medical officers would do well to impress upon other officers the value of this to their own welfare. The Navy has kept step with all the advances made along this line, and its present annual physical examination is of such a character that it might well be used as a guide by civilian physicians in conducting their examinations. The future will show the value of the procedure and the results will undoubtedly justify the present increasing enthusiasm.

ARGYRIA

Not long ago a request for information as to the chance of producing argyria by the use of argyrol as a nasal spray was received from a medical officer. As the use of argyrol and other organic silver salts is very common in the Navy, it seems probable that other naval medical officers may at times be a little uncertain as to the desirability of continuing the use of these compounds. Therefore, a search of the literature upon this subject was made in order that the facts might be presented to the readers of the Bulletin.

Argyria, at present, is not common. It was not uncommon in the early part of the nineteenth century because of the widespread use of silver nitrate in the treatment of epilepsy and tabes dorsalis. During recent years there has been an increase in the number of cases because of the extensive use of the colloidal preparations of silver.

Argyria is of two types—generalized and localized. In the generalized type, the characteristic feature is a bluish, slate-colored discoloration of the skin which may involve the entire body. According to C. N. Myers (Am. J. Syph. 7:125:1923), this discoloration is due to a combination of the chlorides in the tissues with the silver salts, the chloride of silver being formed. This, in turn, is decomposed by light to form either argentous chloride, an oxychloride of silver, the black oxide of silver, or metallic silver itself. The rate of penetration of the silver is influenced by the chlorides; the depth of penetration depends upon the concentration of the chlorides; and the seat of the stain is determined by the amount of chlorides present.

The generalized form of argyria is, according to Myers, always due to internal medication. That this is not absolutely the fact is shown by case reports which will be cited below.

The localized form occurs among metal workers and patients who have received local applications to the mucous membranes of the nose, throat, conjunctiva, or urethra. Myers states that, "In local argyria the silver penetrates directly into the skin or by way of the mucous membrane and the discoloration never goes beyond the place of application."

The same writer tells us that there have been 44 cases of generalized argyria reported in the literature, the first report being made in 1647, and that 36 cases of the localized form have been reported since 1857. Of these, 4 have followed the use of protargol and 10 the use of argyrol. Other forms of silver which have caused one or more cases of the localized type are silver nitrate, albargin, and metallic silver dust. In all cases the amount used was small and it

is quite possible that, had this been larger, generalized argyria would have resulted. However, the insolubility of the colloidal forms of silver renders the generalized type very improbable. The use of drops is more likely to cause staining than are even stronger solutions when applied with a brush.

O. P. Kimball, in the Ohio State Medical Journal of May, 1922, reports a case of the generalized type in a young man who, while under treatment for duodenal ulcer, took 10 minims of 10 per cent silver nitrate solution after each meal for 8 months. Computation shows that during this time he took a total of 1½ ounces of silver nitrate or approximately 1 ounce of metallic silver. It is not surprising that argyria developed.

This same writer quotes Fromann who, in 1859, gave the most complete report of a case of argyria with the clinical history and autopsy findings, both gross and histological. The pathology of the condition as described by Fromann is as follows: There is a discoloration of the skin produced by impregnation of the underlying tissues with very fine silver granules. The epidermis remains clear, the silver deposits lying beneath it in the derma, the connective tissue, about the hair follicles and the sebaceous glands, around the smooth muscle fibers, around the medium-sized arteries and veins, and in the adventitia of the smallest vessels. The nonelastic substance of the connective tissue is almost free. The other organs and tissues show the same changes as are found in the skin. The intestinal canal is heavily impregnated. The choroid plexus is discolored. In the blood there is a definite stippling of the red cells. Anemia is frequently associated with argyria.

That the generalized type may follow what is intended to be only the local application of the silver salts is shown by H. I. Goldstein (J. A. M. A. 77:19:1921), who reported such a case as having followed the local use of argyrol in the throat for one year. At the time he was seen by Goldstein, the color had persisted for eight years.

T. D. Davis reported two cases in the Virginia Medical Monthly of June, 1924. One of his cases followed spraying 25 per cent argyrol into the nose and throat for several months, while the other had been using a solution of argyrol on the gum margins at frequent intervals for several years.

Gottheil reported a case of generalized argyria in a man who had used 10 to 15 per cent silver nitrate for ulcerative throat trouble for more than seven years. (J. Cutan. Dis. 29:2:1911.)

All of these cases show clearly that generalized argyria may occasionally follow the local use of the salts of silver. It must be noted, however, that in every case reported the argyrol or other compound was applied to the mouth or nose over a considerable period of time. Of course, it is not only possible but probable that

much of the solution found its way into the alimentary tract from which it could be absorbed in the same manner as if it had been internally administered.

Only one case was found reported in which argyria followed the injection of colloidal silver salts into the urethra. A. Davidson reported one such case in the Journal of Cutaneous Diseases (34:605:1916) the victim being a young man who treated himself for gonorrhea. He first used 10 per cent argyrol solution, later increasing its strength and also using protargol and albargin. Three weeks after beginning treatment, he noticed that the backs of his hands were becoming "reddish." In six weeks they took on a definite bluish tinge and his whole body became of a muddy hue. He used the injections three times a day retaining the solution for five minutes each time.

Localized argyria, as has been stated, has been reported 36 times since 1857. Fourteen of these followed the use of the organic salts. The majority involved the conjunctiva alone or the conjunctiva and adjacent skin. The histories of these cases show that the great danger lies in injecting the solution under pressure or in using it where the tissues have been lacerated. One case reported by G. M. Olson (J. A. M. A., 69:2:1917) illustrates this. The patient, a young lady, had sustained a fracture of the nose four years previously. A physician dropped argyrol into the right eye. The fluid penetrated into the tissues of the eyelid, nose, and cheek and a bluish green and slate gray pigmentation resulted.

Treatment of the condition is almost entirely preventive. After argyria has once developed, there seems to be nothing that will cause the discoloration to fade out, although in the case of localized argyria reported by Olson and in a generalized case reported by A. M. Crispin (J. A. M. A., 62:18:1914), hexamethylenamin was used and some of the pigmentation disappeared.

In brief, it may be stated that the danger of generalized argyria from the use of organic silver salts is very slight. The localized type may be caused by injecting the solutions under pressure, thereby forcing some of the staining material into loose connective tissue. The use of silver salts of any kind in or near lacerated wounds should be avoided. It is safer to apply the silver solutions with a brush or swab rather than to use them in the form of drops and it is unwise to prescribe them for self-administration at frequent intervals over an extended period of time.

LOW BACK PAIN

These distressing conditions are met with so commonly that the tendency among both medical men and the laity has long been to

neglect them unless they become so severe as to incapacitate. Even when a state of comparative helplessness results from the pain, it is rare for the sufferer to be given a complete examination in the effort to arrive at a diagnosis. Too often he is dismissed with the advice to rest, use plasters, bandage himself tightly, take aspirin or a dose of salts, and is given the assurance that he will be all right in a few days. In some cases, this assurance proves justified, but in many cases it does not, and the large number of sufferers who receive no relief from the usual methods of treatment form a part of those unfortunates who eventually fall into the hands of practitioners of the many irregular cults, sometimes receiving benefit from the manipulations given them.

If these sufferers are to retain their confidence in medical men and methods, more effort must be made to search for the cause in every case of low back pain, as, unless the cause is found, no rational treatment can be prescribed.

In Archives of Surgery (11:6:December, 1925), a paper entitled "Painful conditions in the lumbar, lumbosacral and sacro-iliac regions," by John M. Berry throws considerable light on the causation of these pains and offers some new aids to diagnosis.

The writer points out the necessity for having some sort of a working basis in attempting to arrive at a diagnosis and gives a classification which he has found useful in his own work. This classification follows:

Classification of low back pain for purposes of diagnosis

- Long-standing cases
  - Gynecologic.
  - Genito-urinary.
  - Medical
    - Constipation.
    - Nervous, neurotic, or hysterical.
    - Spinal inefficiency.
  - Static
    - Weak feet.
    - Bad posture.
    - Scoliosis.
    - Chronic strain.
    - Large abdomen.
    - Occupational strain (surgeons and dentists).
  - Conditions shown by Röntgen-ray examination.
    - Ostearthritis.
    - Abnormalities of bone.
- Acute or subacute cases without trauma
  - Associated with fevers.
  - Myalgia.
  - Toxemias.
  - Diseases
    - Osteomyelitis.
    - Infectious arthritis.
    - Gonorrhea.
    - Typhoid fever.
    - Tuberculosis.
    - Syphilis.
    - Neoplasms.
  - Cord tumors.
- Trauma cases
  - Röntgen-ray examination, positive
    - Fracture.
    - Dislocation.
    - Kümmel's disease.
  - Röntgen-ray examination negative—strain or sprain.
    - Lumbar.
    - Lumbosacral.
    - Sacro-iliac.

This classification is self-explanatory and requires no lengthy discussion. Formerly, it was thought that almost all low back pain in women was due to malposition of the uterus or to some ovarian trouble. Now it is known that only a small proportion of such pain is gynecologic in origin. Genito-urinary conditions (prostatitis, urinary calculi, hydronephrosis, etc.) may cause low back pain rarely. Constipation, nervous backache, and spinal inefficiency are medical conditions frequently met with in these cases. Spinal inefficiency manifests itself in inability of the spinal column to support the body properly. A light spinal support will usually relieve these cases. Weak feet and bad posture should be corrected. Scoliosis is an infrequent cause of backache.

Chronic strains result from tension on the ligaments, due to weakness of the muscles which maintain and change the positions of the body. A common cause is a large abdomen—which suggests its own remedy—while probably the commonest cause is occupational, for example, surgeons and dentists working in one position for a long period of time.

The author recommends that every patient with pain in the back be given an examination by means of the X rays. This may reveal osteoarthritis of the spine, calcification of the iliolumbar ligaments, "painful epiphysitis of adolesence," "arthrosis obliterans," or some abnormality of the bones of the lumbar, lumbosacral, or sacro-iliac regions. These abnormalities are numerous and frequent and are not always associated with pain. It has not been possible always to connect definite types of deformity with definite clinical symptoms.

Anomalies of the transverse processes of the fifth lumbar vertebra are assumed to be the most frequent cause of back pain due to abnormalities. The anomaly may be only a departure from normal in length, size, or shape, or it may be sacralization.

Richard is quoted by Berry as concluding that the pain in these cases may be due to the following causes:

"1. Compression of soft tissue.

"2. Irritation and arthritis of abnormal joints and bursae.

"3. Slow acting strain on ligaments.

"4. Pressure or tension of the segment of a nerve trunk."

Shackleton is stated by the writer to believe that the following factors are involved:

"1. Impingement of the processes on the ilium, separating the sacroiliac joints.

"2. The transverse process acting as a fulcrum separating the lumbosacral joint.

"3. Erosion of the ilium.

"4. Hyperplasia of the surrounding tissues, including the nerve."

It is stated, as showing that abnormalities really may play a part in the production of pain, that, while only about 30 per cent of per-

sons seem to have abnormalities of the transverse processes, 61 per cent of those known to have such also have back symptoms.

Operative procedures have brought relief to many of these sufferers but should not be resorted to until other simpler methods of treatment have been tried and found of no value.

Neural arch defects of several types are found, but it is doubtful if these in themselves cause symptoms. However, the author shows that if the defect is of such a character as to interfere with the normal attachment of the ligaments, weakness of the support must follow and with it pain.

It has, of course, been known for a long time that the facets between the body of the last lumbar vertebra and the upper surface of the sacrum do not occupy the same plane in all persons. This is of great importance, because the position of the facets determines the degree of strength and stability at the articulation. The plane of the articulation should lie vertically and extend "outward and backward from the sagittal plane of the body at an angle between 45 and 90 degrees." Heretofore, no technic has been developed whereby the position of the facets could be determined in the living subject. The writer believes he has found a way to accomplish this by means of the X ray and describes the process as follows:

"The usual anterior posterior roentgenogram is made with the patient lying on the back and the tube centered in the midline, a little below the level of the anterior superior spines. With the facets in a normal position they can not be made out in this roentgenogram. The patient is now rotated, say to the left, about one third the distance toward a direct lateral position, and a second roentgenogram made. If the facets are normal the left articulation will begin to open up. If the articulation completely opened up in this position, it would mean that it formed an angle with the sagittal plane of the body of about 30 degrees. The patient is now rotated to about two-thirds the distance toward a direct lateral position, and a third roentgenogram is taken. If the facets approximate the normal, the articulation will now open up still more, corresponding to an angle of about 60 degrees with the sagittal plane of the body. By comparing the appearance of the articulation in the different roentgenograms the angle made with the sagittal plane of the body can be computed fairly accurately, and any tilting of the joint from the vertical can easily be made out and estimated."

It is well known that the lumbosacral joint is not stable, and that there is always a tendency to strain at the joint because of the angle of junction. Backache may result from a prolonged normal strain or the angle may be greater than usual. The plane of the articulation may be obtained by the use of a Bucky diaphragm, the roentgenograms being taken laterally with the patient standing.

Describing the joint and giving the reasons why strain so often occurs at this point, the author says:

"The spine rests on the sacrum, being held in position by the articular processes between the fifth lumbar vertebra and the sacrum, the ligaments and the muscles. If the upper surface of the sacrum were parallel to the horizon there would be little strain at the lumbosacral junction in the upright position, but this is not so. The upper surface of the sacrum is inclined downward and forward, the average angle being about 42 degrees. Any increase of this angle naturally would increase strain, therefore this angle should be determined in all cases. Another factor influencing strain is the angle at which the fifth lumbar vertebra joins the sacrum. If the under surface of the fifth lumbar vertebra were parallel to the upper surface of the sacrum the resulting shearing strain would be represented by a vertical line projected against a 42-degree angle; but if, as usually happens, the under surface of the fifth lumbar vertebra is opposed to the top of the sacrum less away from the horizontal than the upper surface of the sacrum, then the greater this angle the greater would be the tendency for the spine to slip off the sacrum, and consequently the greater the shearing strain. A record of this angle (the normal average of which seems to be about 10 degrees) should be made in all cases. The shearing strain may then be indicated by the angle that the top of the sacrum makes with the horizontal plus the angle between the bottom of the fifth lumbar vertebra and the top of the sacrum (normal shearing strain=42 degrees plus 10 degrees)."

If the painful back proves to be due to an increase in the shearing strain at this joint, the avoidance of strain and the use of supports should be tried. If these fail, operation to ankylose the joint is justifiable.

Not all back pain, however, is due to abnormalities of the bones or joints. Toxemias and infections are frequent causes, and neoplasms are occasionally responsible. Trauma is a not infrequent factor in producing back pain, and every patient with injury to the back should have an X-ray examination. A fracture or dislocation may be disclosed. When the X-ray examination is negative there may be a strain or sprain of the lumbosacral or sacro-iliac region, and "sacro-iliac strain" has become a favorite diagnosis in spite of the fact that some orthopedists practically deny that such a condition can exist. Theoretically, the author shows, there seems to be no reason why sacro-iliac strain might not be possible. The anatomical relations of the bones and the supporting ligaments render the condition not unlikely.

Sciatic pain is a frequent accompaniment of back pain. This is explained by the occurrence of traumatic inflammation in the ligaments, which in turn produces swelling and inflammation in the surrounding tissues and the nerves.

Treatment for back pain is described by Berry as follows:

"Treatment varies with the severity of the case. First of all too strong emphasis can not be placed on a thorough treatment of the original injury. The patient should have rest in bed and freedom from strain of any sort until the symptoms have disappeared. The relief of pain may be hastened by the use of radiant heat on the back and also by adhesive strapping. In strapping a back for this condition the most efficient and comfortable form of strapping has been found to be 2-inch wide (5 centimeters) adhesive straps, which are applied circularly around the body, but which leave the front of the abdomen free. They extend from the level of the trochanter of the femur to the dorsal region of the spine. After the first layer of circular straps has been applied a vertical layer is put on, and this in turn is followed by another circular layer. If the case does not clear up promptly, or if there is any tendency to recurrence, the patient should wear a support, and be warned against the strain of lifting or of working in a bent-over position. Sciatica should be treated by rest in bed and a Buck's extension. If 'sciatic scoliosis' is present and a Buck's extension will not clear it up, it may be necessary to give the patient an anesthetic, to reduce the deformity and to apply a plaster cast (hip spica) until pain and disability have ceased. The patient should then be fitted to a support and warned against strain. When conservative treatment as here outlined has failed, the only logical thing to do is to fix the part by a bony union."

Because of the importance of a systematic history taking and examination in these cases, the author has prepared a very complete questionnaire covering all points necessary to be brought out to arrive at a correct diagnosis and especially to differentiate between lumbosacral strain and sacro-iliac strain. The examination includes many motions on the part of the patient to bring out muscle spasm and pain as well as a search by the examiner for sensitive spots along the ligaments and nerves. A rectal examination is also made.

In analyzing the examination, Berry shows there is nothing characteristic about the complaint. Dull, heavy pains are apt to be due to chronic conditions, while sharp pains are usually associated with acute inflammation. The determination of the points to which pain is referred is of some importance, the commonest being the posterior aspect of the thigh, the anterolateral and posterior aspects of the lower leg, and the lateral aspect of the ankle. The onset of the pain is of great importance. Immediate onset after trauma, of course, renders trauma the most likely cause. A feeling of "something giving away" usually means a tearing of a ligament followed by strain. Myositis would be suspected if the onset follows an

exposure to cold. In various conditions the pain is intensified by different movements and positions. In strain, bending over or lifting will increase the pain. It is stated that a patient with lumbosacral strain is comfortable when lying on the back or either side, while one with a sacro-iliac condition can not lie for any considerable length of time upon the affected side. Rest in bed benefits the condition if it is due to a disease of the spine, while in chronic strains, the condition is apt to be worse in the morning. A thorough neurologic examination should be made if there is loss of sensation, ataxia, or if abnormal reflexes are found.

In conducting the examination, many things must be noted. The walk, the posture, the presence or absence of a large abdomen, curvature of the spine, listing of the trunk, flexion or extension of the spine when standing, lateral bending, atrophy and other conditions should be looked into carefully. Palpation, to bring out sensitive points, is of great value. As stated, rectal examination should be made. This may reveal, or rule out, pelvic tumor and prostatic disease. Also, it may reveal a sensitive tip of the coccyx. Various passive motions of the spine and legs must be made and the results observed. Compression of the crests usually produces pain in acute sacro-iliac trouble. Also compression of the pubis. Last, but not least, comes the X-ray examination. This has already been described.

It is interesting to note, as an evidence of the importance of this subject, that in the same number of Archives of Surgery in which Berry's article appeared, there is a paper by W. H. Robinson and H. W. Grimm in which is given the technique by which they measure the sacrovertebral angle and in which they discuss the clinical significance of its variations.

HEXYLRESORCINOL AS A URINARY ANTISEPTIC

In recent numbers of the Bulletin there have appeared abstracts and discussions of several papers dealing with efforts to find a *therapia sterilisans magna.* Mercurochrome, acriflavine, gentian violet, the arsphenamines, stovarsol, and tryparsamid are among the remedies brought forward in the hope that they would fulfill all the requirements. Each one of these new remedies has served and is serving a useful purpose, and is a valuable addition to our defense against disease, but none, so far, has been the hoped-for infallible remedy.

In April, 1925, Veader Leonard of the Johns Hopkins University, before the symposium on "Chemistry in the field of microbiology," read a paper entitled "The significance of hexylresorcinol and its homologues in relation to the problem of internal anti-

sepsis." This was published in Science (LXII; 1610; November 6, 1925). Its more important features follow.

Leonard begins his paper with an expression of regret that such a broad term as "chemotherapy" should have become so restricted in its application as to mean the treatment of specific general infections by chemical means. In reality, the use of iron in anemia, quinine in malaria, sodium bicarbonate in gastric hyperacidity, and many other common drugs used in various conditions, are all examples of real "chemotherapy."

The writer uses the term "internal antisepsis" as meaning the treatment of infections by means of the internal administration of chemicals, and applies the term "systemic disinfection" to what has commonly been called "chemotherapy."

In the words of the writer:

"Ehrlich's conception that the pharmacodynamic activity of a given substance is due to fixation by or chemical reaction with the cell protoplasm led him to distinguish two varieties of biochemical affinity. To the property of ready fixation by the protoplasm of tissue cells he gave the term *organotropism*, and designated by the term *parasitotropism* the property of fixation by the cell protoplasm of microorganisms. The question at once presents itself: Might it not be possible by a study of these properties, as exhibited by various substances of known chemical constitution, to evolve some stable complex so highly parasitotropic and at the same time so slightly organotropic as to accomplish complete disinfection of the blood stream and tissues at one stroke (*Therapia sterilisans magna*), or, failing this, a substance showing at least a large ratio between the smallest curative dose and the largest nontoxic dose (Therapeutic index)?

"Unfortunately, efforts to discover such a substance have been so uniformly disappointing as to discourage the hope of developing any drug (whose parasitotropic action *in vivo* is not highly specific) which could, in the strict sense of the term, be considered a systemic disinfectant. Although Ehrlich and Bechhold were able to increase very greatly the bactericidal power (parasitotropism) of various phenolic substances, this was usually accompanied by an equivalent increase in toxicity (organotropism). In no instance, either in Ehrlich's work or in the many researches which have followed it, has it been found possible to introduce into any substance a nonspecific parasitotropic surplus definitely attributable to chemical constitution and sufficiently pronounced to offer real encouragement."

The problem of systemic disinfection might be simple if the only points to be considered were the two types of protoplasm—that of the parasite and that of the host. It is complicated, however, by the facts that in the higher animals there are a large number of

highly differentiated types of protoplasm which react differently to the same drug or chemical and that a substance introduced into the body will in all probability undergo a number of chemical changes. All important advance along therapeutic lines has been due to this latter fact. The specific parasitotropic action of various recently introduced substances can be explained only by assuming that they posses tissues affinities without which their therapeutic action could not occur.

The Gram stain proves "the existence of a particular chemical characteristic common to large groups of widely different forms. In their comparative simplicity lies the suggestion that unicellular organisms, as a whole, or at least certain groups of them, may share some common characteristic essential to the chemistry of their life processes, which might be dissimilar to anything occurring in any of the tissues of the higher animals. The idea of systemic disinfection by chemical means is necessarily based upon the hope that some such difference exists, whether it be common to all bacteria, to large or small groups, or merely to definite species, and is supported by the possibility that such a difference might be utilized to our advantage without any accurate knowledge of its chemical nature."

The search for an internal antiseptic has followed two lines of attack both of which are compromises of Ehrlich's ideal. These two lines of attack have been as follows:

"(1) Attempts to reduce the unfavorable effect on the tissues of the host of substances which, administered internally, are known to exhibit a high degree of specific toxic action toward the particular organism responsible for certain diseases.

"(2) Attempts to impart active and nonspecific bactericidal or bacteriostatic action to relatively nontoxic substances known to possess the property of rapid concentration in certain tissues or rapid elimination into certain body fluids."

The best examples of the first type of research are the arsphenamines, while work done with the trypan dyes, sulphonephthalein, and other similar substances afford examples of the second type.

Chief among the difficulties encountered in both types of research is the fact that the action of the substance *in vitro* gives little indication of its action *in vivo*.

In explanation of this Leonard says:

"In the first place most antiseptics and germicides become inert or suffer marked deterioration of their active properties in solution in such fluids as blood serum, urine, etc., or even in the presence of relatively small amounts of organic matter. The germicides of the chloramin type, of which so much was formerly expected, are excellent examples of this imperfectly understood interfering action. On

the other hand, substances which retain at least a portion of their bacteriostatic or bactericidal properties in solution in biologic fluids are very likely to be destroyed in the body or rendered inert by conjugation.

"Finally, antiseptics and germicides which retain their activity in biologic fluids seem to lose the special physiological affinities characteristic of similar substances which are either without any antibacterial action whatever or which lose it in solution in biologic fluids. As an example, Davis found in his elaborate search for an internal urinary antiseptic that among the hundreds of compounds he examined those which were rapidly excreted into the urine invariably lost their bactericidal action in solution in this fluid, while those substances which retained their bactericidal properties in urine were not excreted by the kidney, in spite of the fact that in many instances they were closely analogous compounds and might have been expected from their chemical constitution to possess a considerable degree of renal affinity."

Twelve years ago the writer, in conjunction with Leo F. Rettger, made a biological examination of the lower homologues of the alkyl resorcinols which had been synthesized by Treat B. Johnson, of Yale, and found them to possess high bactericidal power and relatively low toxicity. Because of the rapid elimination of the lower members of the series in the urine, it seemed desirable to study the higher members in the search for a satisfactory urinary antiseptic. The entire series was synthesized, and, in the words of the author:

"A biological examination of these compounds led to astonishing results. Each increase in the weight of the alkyl chain resulted in a remarkable increase in bactericidal power and this with at least no apparent increase in toxicity when administered to rabbits by stomach tube. The peak of bactericidal power was reached in hexylresorcinol, which, with a phenol coefficient variously estimated at from 46 to 56.3 by the United States Hygienic Laboratory method now in use, is probably the most powerful phenolic germicide ever described. In spite of this, however, daily administration by mouth of doses of 0.5 gm. to rabbits for 21 consecutive days, and single doses as large as 2.5 gm. (1.0 per kilo) resulted in no immediate or remote toxic effects which could be detected either by renal function tests, urine, and blood examinations during the period of observation or later, by microscopic examination of stained sections of all the more important organs. In fact, most of the animals saved for late observation after prolonged courses of hexylresorcinol showed remarkable gains in weight."

Leonard does not give the details of his experimental work in this paper, as it has been published elsewhere, but he does show that the administration of from 0.3 to 0.6 gm. three times a day to normal

men resulted in the secretion of bactericidal urine which, in the test tube, was capable of destroying strains of *B. coli*, *Staphylococcus albus* and *aureus* which had been isolated from cases of active pyelitis.

"Hexylresorcinol was found to be:

"(1) Chemically stable.

"(2) Nontoxic in highly effective doses.

"(3) Nonirritating to the urinary tract.

"(4) Bactericidal (not merely bacteriostatic) in high dilution in urine of any reaction.

"(5) Eliminated in high percentage by the kidney, largely as an inert conjugate, but unchanged in sufficient amount to impart definite bactericidal properties to the urine."

Hexylresorcinol is the only substance that has been proved to meet all of these requirements. In addition, it may be given by mouth for long periods and thus exert a continuous action in the urinary tract.

During the past year large numbers of patients have been treated with hexylresorcinol by Leonard and others and the results have been highly satisfactory. Many cases of cystitis and pyelitis which have resisted all other forms of treatment have responded quickly to the oral administration of this drug alone. No untoward effects have been observed in any case among the more than 500 who have been so treated.

Concluding his paper, Leonard says:

"In summary, hexylresorcinol is by far the most powerful germicide ever discribed as possessing anything like its degree of nontoxicity to animals and to man. It has been developed and applied as an internal urinary antiseptic by a logical and orderly application of the chemical and biological characteristics of its lower homologues and exemplifies a method by which specific problems in internal antisepsis may be gradually narrowed down through the enhancement of desirable biological properties definitely attributable to chemical constitution."

A later paper by Veader Leonard and Austin Wood on "The present status of hexylresorcinol as an internal urinary disinfectant" appeared in the Journal of the American Medical Association of December 12, 1925. It repeats much that was published in the earlier article, quoted above, but carries the study further and gives a more detailed account of the method of action of the drug.

Various methods of administering hexylresorcinol have been tried and the authors have found "that the expectancy of bactericidal urine in normal men is definitely higher on equivalent doses of hexylresorcinol in solution in olive oil than with any other form investigated." For convenience, the solution is given in soluble gelatin capsules.

Doctor Leonard has previously shown that if soda is administered to persons who are taking hexylresorcinol the urine will not develop bactericidal properties. This can not be due to the fact that soda renders the urine alkaline, as hexylresorcinol, both *in vitro* and *in vivo*, is just as active in alkaline urine as in acid urine. The explanation of this "interfering action" of soda has been determined. It depends upon a raising of the surface tension by the soda.

It has been shown by Billard that the rate of diffusion of a sugar solution through a semipermeable membrane is greatly increased by a lowering of the surface tension. Diffusion of a germicide through the cell membrane of an organism necessarily precedes the action of the germicide upon the organism. Therefore, "it is reasonable to suppose that any factor controlling the rate or extent of that diffusion would equally control the rate or extent of the disinfection."

The authors proved that, in the test tube, dilutions of hexylresorcinol too weak to destroy the organisms became effective if the surface tension of the solution was lowered by the addition of some substance which, in itself, had no germicidal action.

It follows naturally, therefore, that a germicide which has the power to reduce surface tension has great advantages over one which does not possess this power. Hexylresorcinol possesses this power in a high degree and it seems probable that its unusual bactericidal properties depend largely upon this.

Experiments were conducted to show the effect of various substances on surface tension. The results were as follows:

"The surface tension of normal urine is in the neighborhood of 60 dynes per centimeter.

"Administration of hexylresorcinol to normal men in therapeutic doses reduces the surface tension of the urine to the neighborhood of 50 dynes per centimeter.

"Administration of sodium bicarbonate to normal men in therapeutic doses raises the surface tension of the urine to the neighborhood of 66 dynes per centimeter and above.

"Merely by forcing water, the surface tension of the urine of a normal man may readily be raised by from 15 to 20 dynes per centimeter."

It was found that the urine of normal men receiving hexylresorcinol was almost invariably bactericidal if the surface tension was 50 or below, while urines with surface tension above 66, following the administration of soda or of large quantities of water, were inert.

As a result of these findings, the authors reach the conclusion that the customary method of treating urinary infections by alkalization and "forced fluids" is of no value in chronic infections. If

chemical disinfection is to be attempted, these measures defeat the object. The least favorable reports on the clinical value of resorcinol have come from those urologists who require their patients to take large quantities of water.

Hexylresorcinol, up to the date of this report, has been used in about 500 properly controlled cases of various types of urinary tract infections. Cases of chronic infections with *B. coli* have yielded after persistent treatment with hexylresorcinol combined with the usual local measures. Chronic staphylococcus, streptococcus, and gonococcus infections have been found to respond readily to this treatment—in some cases almost immediately. Miscellaneous cases of other types have been greatly benefited.

So far the authors have found sodium bicarbonate to be the only drug contraindicated in conjunction with the hexylresorcinol treatment. Nephritis is not a contraindication to the use of the drug, no irritation of the kidney having been observed after repeated doses to rabbits or to normal men.

In the treatment of chronic infections of the urinary tract will be found the greatest field of usefulness for hexylresorcinol.

In conclusion, Leonard and Wood call attention to four factors which must be borne in mind if the best results are to be obtained from the use of this apparently valuable drug. These are:

"1. The dosage must be adequate. On less than from 0.45 to 0.6 gm. three times a day (from three to four capsules immediately after each meal), the surface tension of the urine will not be lowered sufficiently to obtain the maximum disinfectant action.

"2. Fluids must not be forced. This procedure raises the surface tension of the urine, and thereby robs it of its bactericidal action. In many instances, quantities of water may be a prime necessity. Under these circumstances it is just as well to postpone active antiseptic therapy until the amount of fluid ingested can be safely reduced.

"Sodium bicarbonate is contraindicated for the reason that it raises the surface tension of the urine, and, like large quantities of water, thereby robs the urine of its bactericidal properties. Hexylresorcinol is equally efficacious in alkaline and in acid urine.

"4. The course of treatment with hexylresorcinol must be sufficiently prolonged. Among the organisms commonly found in urinary tract infections, those which are most resistant to surface tension changes in the test tube (colon group) are most resistant to the action of hexylresorcinol *in vivo*. Urinary infections by *B. coli* and related types ordinarily require from 60 to 90 days' continuous treatment with the drug. If combined with the usual local measures, the course of treatment will be shortened and the percentage of ultimate cures increased."

TESTS OF CURE IN EXPERIMENTAL SYPHILIS

Much work has been done in recent years at the Hygienic Laboratory to determine the relative value of the different arsenicals in the treatment of syphilis and in the effort to arrive at a criterion of cure. The latest report dealing with this work is made by Carl Voegtlin and Helen A. Dyer and appears in Public Health Reports of November 13, 1925. In it, the writers give some of the results obtained from their experiments conducted during the past two years.

The primary object of the work done was to determine "whether or not a given agent under certain conditions is capable of curing an infected animal," the term "cure" being used to mean that all *Treponemata* in the infected host have been destroyed.

Two methods were used to determine this question. The older "is based on the result of reinoculation with *T. pallidum* some time after treatment. If reinoculation is successful, as shown by the appearance of a typical primary lesion containing spirochetes, the animal is supposed to have been cured of the first infection; if unsuccessful, it is thought that infection still existed. * * *." Previous work with this method led Kolle to the conclusion that a biologic cure of syphilis in the rabbit is possible when treatment with repeated large doses of arsphenamines is given within 45 days after the primary inoculation, but that if treatment is started later, cure can not be obtained.

"The second method was introduced by Pearce and Brown (1922) and is essentially based on the fact that syphilitic infection in the rabbit appears to involve, with great regularity, infection of the lymph glands. If the popliteal nodes of a treated animal are extirpated, macerated, and injected into the scrotum of normal rabbits, the occurrence of chancres in the latter is taken as indication of failure to cure, and, vice versa, if chancres do not develop, as evidence of cure of the donor. This method was used for the evaluation of the curative action of arsphenamine in rabbit syphilis by Nichols and Walker (1923) and Chesney and Kemp (1923), and of neoarsphenamine and sulpharsphenamine by Voegtlin, Armstrong and Dyer (1923). The results of these investigations suggest that it is possible to cure some rabbits with these remedies, even if treatment is postponed for 60 days or 90 days after infection. These results, therefore, are in obvious conflict with the conclusions reached by Kolle."

The work of the writers confirms the results of Kolle, but they interpret the facts differently.

Voegtlin and Dyer inoculated a series of 36 rabbits with the Nichols strain of *T. pallidum* in August, 1923. All but one of the animals developed typical chancres. Spirochetes were present in

all but three, these being excluded from further experiments. The remaining animals, two months after inoculation, received a single intravenous injection of arsphenamine, neoarsphenamine, or sulpharsphenamine, the dose being so regulated that all the animals received the same amount of arsenic irrespective of the form in which it was given. Two and one-half months later, all chancres having disappeared, the rabbits were reinoculated with a testicular emulsion of the same strain of *T. pallidum*. To demonstrate the virulence of the suspension used for reinoculation, three normal rabbits were injected at the same time. Two of these developed typical chancres, and the other died before sufficient time had elapsed for the development of a lesion. Thirteen of the animals were given a second reinoculation, 26 normal rabbits, all of which developed chancres, being injected at the same time. Seven weeks after the last inoculation Wassermann and Sigma tests were made on the blood of the animals.

Dark-field examination of serum obtained from the lesions four days after treatment was negative in every case. The time required for healing of the lesions varied considerably, but was no longer with sulpharsphenamine than with the other drugs. No clinical relapse occurred within 2½ months.

Discussing the relative value of the three drugs tested, the authors say: " Previous work has shown that arsphenamine of various manufacturers does not show any appreciable differences in trypanocidal action, whereas various commercial neoarsphenamines and sulpharsphenamines reveal considerable variation in trypanocidal action. The present experimental data therefore suggest that the therapeutic potency of sulpharsphenamine, as judged by the healing of syphilitic lesions and freedom from clinical relapse, is at least as good as that of arsphenamine, in spite of the fact that the trypanocidal potency of the former drug is less than that of arsphenamine. These observations are in agreement with the conclusions of Stokes and Behn on the relative therapeutic action of the two drugs in clinical cases."

Only 19 of the animals are included in the discussion of the results obtained by reinoculation, the remainder dying. The data compiled show that, in this series, reinoculation yielded consistently negative results.

"These results are therefore in harmony with those obtained by Kolle, and indicate that, on reinoculation, it is not possible to produce typical chancres in rabbits when 2½ months intervene between primary infection and treatment. It is significant that the lymph gland transfer from four treated animals after two unsuccessful reinoculations gave positive results, clearly indicating the presence of syphilitic infection in these treated animals. This conclusion is

furthermore strengthened by positive Wassermann and Sigma tests, which were made seven weeks after the last inoculation. Only three of the animals yielded negative serum tests. The question is whether this plain evidence of syphilitic infection after reinoculation is proof for incomplete cure of the primary infection or whether it may be considered as evidence indicating that the primary infection was actually cured and that reinfection occurred without the production of a local lesion at the site of reinoculation."

Either the first infection was cured or it was not cured. Nichols and Kolle have shown that, if reinoculation is performed within 40 days, chancre will be produced. In the experiments under discussion, 2½ months elapsed before reinoculation and no chancres developed. It would seem, then, that after a certain length of time. a syphilitic infection brings about a condition in which reinoculation does not result in the development of chancre, and that, in this series, none of the animals had been cured. On the other hand, it might be that, "on account of the long time intervening between primary inoculation and treatment, the tissues may have acquired a resistance which prevented the development of a chancre at the site of reinoculation, but which did not prevent the establishment of a latent infection in the lymph glands."

As a result of their work, the writers state that both methods for the determination of cure involve an element of uncertainty. "The reinoculation test, if positive, is fairly good evidence of cure; if negative it may indicate either (1) that the animal has not been cured or (2) that a cure has been effected, but on account of an acquired relative immunity the tissues are protected against the production of a chancre. If positive, the lymph gland transfer method is conclusive evidence of failure to cure; if negative, the experiments must be sufficiently numerous in order to permit the conclusion that the treatment had produced a cure * * *." As a result of this and other work yet to be published, they have adopted the lymph gland transfer method in their laboratory.

In connection with the experiments which have been discussed, Voegtlin and Dyer found that animals treated with the three arsenicals mentioned may be resistant to a subsequent inoculation with *T. pertenue* as well as to reinoculation with *T. pallidum*. They do not attempt to explain this phenomenon.

It should be noted that: "Evidence was secured showing that in spite of a relatively low trypanocidal action, sulpharsphenamine is just as effective as arsphenamine and neoarsphenamine with regard to the healing of lesions and freedom from clinical relapse."

WORLD HEALTH CONDITIONS AS REVIEWED IN THE ANNUAL REPORT OF THE SURGEON GENERAL OF THE UNITED STATES PUBLIC HEALTH SERVICE [1]

The Secretary of the Treasury has transmitted to Congress the Annual Report of the Surgeon General of the United States Public Health Service for the fiscal year ending June 30, 1925. This document is of particular public interest, constituting as it does a yearly accounting of the Nation's most valuable possession, its health.

Surgeon General Cumming repeats the warning he gave last year as to the danger of the lowering of standards of health in the United States which may possibly result from overconfidence and relaxation in vigilance in public health work. He also points out the fact that a material increase in the population produces a marked tendency to a more than corresponding increase in sickness and death, and states that this increase will surely follow unless rational, proportionate measures are enforced to prevent it. Had we not learned how to prevent, in great measure, many of our communicable diseases, and were we not provided with the means of applying known preventive measures, our population would be swept from time to time by epidemics, which because of our present congestion and better facilities for rapid transportation, would make past epidemics seem mild in comparison. The people of the United States, in so far as the national health is concerned have grown into a body compact comparable to the human body, no member of which can suffer without affecting the well-being of all.

With the cooperation of the State Department, State and local health authorities, and other agencies, the Public Health Service has developed a very comprehensive system for the collection of world statistics of disease, which, the Surgeon General says, however, is capable of much greater development.

The most important event in the field of international health relations during the fiscal year was the signing of the Pan American Sanitary Code by 18 of the American Republics at Habana, Cuba, on November 14, 1924. This pact provides for the collection and distribution of information concerning the prevalence of communicable diseases and prescribes and standardizes the measures necessary to prevent their transmission from one country to another. By its terms the Pan American Sanitary Bureau is made the central coordinating sanitary agency of the Republics of the Pan American Union. To date, the code has been ratified by the Untied States, Costa Rica, Cuba, Chile, and Peru, and its acceptance by the other signatory countries is expected in the near future.

[1] Health News—Issued by the U. S. Public Health Service.

In spite of the fact that United States seaports are, through maritime commerce, in constant communication with ports infected with plague, and often with cholera and yellow fever—dreaded plagues of a few years ago—there was no importation of these diseases or of other major quarantinable disease during the year, though both human and rodent plague were detected on vessels arriving in quarantine.

For almost the first time in the history of the United States quarantine, there was no detention of ships' passengers or crews on account of yellow fever. A few cases of this disease were reported from El Salvador, Central America, from three countries in South America, and also from the Gold Coast and Nigeria in Africa. The fact that the incidence of yellow fever has at no time in its recorded history been so low is very gratifying. Surgeon General Cumming points out, however, that until it is completely eradicated from the earth, yellow fever will remain a grave potential danger.

Contrasting the relative freedom from the major quarantinable diseases (smallpox excepted) which we nonchalantly enjoy in this country, and emphasizing the protection which the quarantine service and the application of the principles of modern health measures give us, are certain figures from reports of foreign countries. Although these data are said to be, in most instances, incomplete and often fragmentary, they are nevertheless astounding to us in this country who rarely hear of some of the diseases mentioned.

Cholera was reported in many parts of Asia, but with the exception of eight cases in European Russia, this disease was not reported from other countries. India reported more than 276,000 deaths from this disease during the calendar year 1924. This is nearly four times the number reported for 1923.

In spite of the fact that the measures for preventing smallpox are well known and very effective, this disease continues to be widespread and destructive. Incomplete reports from 62 countries included 218,000 cases and more than 50,000 deaths from smallpox during the calendar year 1924. The same countries reported 165,000 cases of smallpox and more than 45,000 deaths during 1923.

The warning issued by the Surgeon General in July, 1924, regarding the menace of smallpox in the United States proved amply justified, since reports from 35 States for the calendar year in 1924 showed an increase of 75 per cent in the number of cases and 628 per cent in the number of deaths as compared with the year 1923. The smallpox case-rate in the United States is at present, according to reports received, the highest of any civilized country in the world. It may be said, however, that much of the disease is of a mild type and in some countries many of these cases would be classed as "alastrim." It is also believed that smallpox is better reported in the United

States than in most other countries. Eleven cases of tetanus, most of them fatal, occurred in the United States during the year as a result of the use of bunion pads as vaccination dressings. Efforts are being made to induce physicians to follow a standard technique when vaccinating, and warnings were issued against the use of shields and bunion pads as dressings.

Bubonic plague has been widespread throughout the world for many years. During 1924, reports of this disease were received from 49 countries, including cases in many important ports and shipping points. More than 400,000 deaths from plague were reported in Asia, and there is little doubt that many more occurred. Nine countries in the Western Hemisphere reported plague, including the United States. The ever present menace of plague has been frequently emphasized in previous annual reports of the Surgeon General. Rodent plague reappeared for a short time in New Orleans, La., and in Oakland, Calif. In both instances, the Public Health Service was asked to assume direction of measures for its suppression and did so at once. No human cases occurred either in New Orleans or in Oakland.

There was an outbreak of plague in Los Angeles, Calif., in which there occurred 33 cases of pneumonic plague with 31 deaths and 8 cases of the bubonic type with 3 deaths during the fiscal year. Both rat and squirrel plague were also found to exist. The Public Health Service assumed charge of plague suppressive measures in Los Angeles just before the close of the fiscal year.

The occurrence of rodent plague in New Orleans, La., and Oakland, Calif., and of human and rodent plague in Los Angeles, Calif., made it necessary for a time to put into effect outgoing quarantine measures in these cities to prevent the infection from being carried to other States and to foreign countries.

Thanks chiefly to our State and local health officers, general health conditions in the United States continued good. Preliminary figures indicate a total death rate for the United States for the calendar year 1924 of about 11.9 per 1,000 as compared with 12.4 in 1923, with 17.6 in the registration area in 1900 and with 19.8 in 1880.

Birth rates in 25 States show an increase from 22.3 per thousand population in 1923 to 22.5 in 1924. The rates varied from 31.6 in North Carolina to 16.1 in Montana.

While infant mortality has shown an appreciable decrease, the number of deaths of mothers incident to childbirth has shown but little change in the last nine years for which data are available. During the period from 1915 to 1922, inclusive, it is estimated that for every 100,000 babies that were born, the lives of from 600 to 900 mothers were sacrificed. About one-third of these deaths were caused by infection of the mother at childbirth, often the result of carelessness on the part of the attendant.

Attention is called to the increasing number of deaths and injuries from the operation of automobiles. The death rate from this cause has risen from less than 1 per 100,000 in 1906 to nearly 15 per 100,000 in 1923, or more than 16,000 deaths per year.

Reports from 36 States show that 111 persons were killed and 1,030 injured as the result of celebrating with fireworks the Fourth of July, 1925. Of the injured, 148 will probably lose the sight of one or both eyes. In many cases, injury or death was due to fireworks considered harmless, such as sparklers, blank cartridges, cap pistols, sky rockets, small firecrackers, and Roman candles. The publicity campaign carried on by the physicians and the press of the United States against the use of fireworks on the Fourth of July had been almost discontinued, as it was thought that warnings were no longer required. The campaign should be renewed.

Heart disease ranks first in the United States as a cause of death, and its incidence is steadily increasing. Influenza and pneumonia combined occupy the second place.

The diphtheria death rate has shown a striking fall from 43.3 per 100,000 in 1900 to 12.1 in 1923. "If parents could be induced to protect their children by the use of the 'toxin antitoxin' process of immunization," says Surgeon General Cumming, "there is no reason why diphtheria might not be still further greatly reduced or even exterminated."

Lethargic encephalitis (sleeping sickness) is apparently increasing in the United States at the present time. In 1923 nearly 2,000 deaths were reported. Data are unsatisfactory, due to imperfect or incomplete reports.

Malaria is stated to be inadequately reported. There are many sections that are relatively free from this disease, while in many others it is still a serious health problem. The rates are higher among the colored than among the while population. Active work in cooperation with State and local health authorities in the effort to combat this disease continues to be carried out.

The death rate from measles has shown but slight change during the last quarter of a century. The inability to control measles, Surgeon General Cumming attributes, in great measure to the fact that there usually elapses a period of about four days from the time of the appearance of the initial symptoms to the time of the appearance of the eruption. Measles is communicable during this stage. The child is not infrequently at school during a part of this time. Many mild cases are never seen by a physician and are never reported. Failure to enforce quarantine measures during the pre-eruptive stage and failure to isolate unrecognized or unreported cases greatly increase the opportunity for its spread. More rigid school inspection, with the exclusion from school of children who have

fever, colds, or who are otherwise indisposed, would remove from contact with other children many incipient cases. Recent scientific research suggests the possibility of producing an immunizing process in this disease.

Although scarlet fever has shown a slight increase in the number of cases reported in 1923 over 1924, the death rate has correspondingly decreased. It is believed that this apparent increase in the number of cases is due to better reporting of the disease.

Little progress has been made in the control of whooping cough during the last 25 years. It is a disease that particularly affects children, especially very young children. One-half of the deaths caused by whooping cough occur in children under 1 year of age and 94 per cent in those under 5 years of age. The education of parents with regard to the extreme danger of whooping cough in very young children is strongly advocated.

The death rate from tuberculosis in the registration area (all forms) dropped from 201.9 per 100,000 in 1900 to 93.6 in 1923. Reports from 35 States having a population of nearly eighty-eight and one-half millions give a death rate of 88.6 for the calendar year 1924.

It is pointed out that at the beginning of the present century the control of typhoid fever seemed almost as hopeless as does the control of measles or influenza at the present time. The application of measures for the purification of water and milk supplies, the exercise of vigilance in protecting other foodstuffs, with prompt recognition and treatment of cases and supervision of carriers, have given a most striking object lesson in the result of intelligent effort applied to the protection of the public health. The typhoid death rate has decreased from 35.9 per 100,000 population in 1900 to less than 7 per 100,000 in 1924. In the original registration area the typhoid rate dropped from 31.3 in 1900 to 3.6 in 1923, and provisional figures for 1924 indicate that there was no rise in these States for the latter year. It must be said, however, that reports for the first half of the calendar year 1925 indicate that typhoid fever rates for 1925 may exceed those of 1924.

Studies of Malta fever indicate that there are two types of the disease to be found in the United States. One of these types is responsible for very considerable losses in cattle, but is apparently not readily transmitted to man. The other type is readily transmissible to man through the milk of goats.

A study of the vital statistics from 1900 to 1923 shows a marked increase in the number of deaths caused by cancer in the original registration States. During the same period the death rate from diabetes has almost doubled.

"The importance of milk as a food and the danger that it may convey disease can not be overestimated," says Surgeon General Cum-

ming. The widest variance has existed in the methods adopted by State and city health authorities to secure a safe and wholesome milk, hardly any two States or cities attacking the problem in just the same way. An attempt is being made to unify measures for the safeguarding of this important food. At the close of the fiscal year 1925, 8 States and 53 cities had adopted uniform measures for the sanitation of milk.

Studies in child hygiene have continued to emphasize the importance of the correction of abnormal conditions found at the school age, such as defective vision and teeth, diseased tonsils, and adenoids. It is estimated that sickness causes the child to be absent 4 per cent of the possible days of school attendance, the common cold being the most frequent cause of absenteeism.

During the winter of 1924–25 an excessive prevalence of typhoid fever was noted in certain cities. In one of these cities the authorities attributed this increase to infected oysters. The publication of this statement throughout the country before the exact source of the oysters was determined led to a marked falling off in the use of oysters and resulted in a considerable financial loss to the oyster producers and workers. The Public Health Service conducted a thorough investigation, definitely traced the infection to shell oysters, and located the distributing point from which the infected oysters came, thereby relieving the whole trade of suspicion and protecting other distributers. The Surgeon General called a conference in the interests of both the public and the oyster producers and resolutions were adopted to serve as a basis for the permanent supervision of the sanitation of shellfish, the details of which are being developed by a committee appointed for the purpose. Congress made an appropriation of $57,600 for this work. The end result will no doubt be better protection for both producer and consumer.

Other important investigations were effected by the Public Health Service of goiter, drug addiction in its relation to crime, nutrition, "sano-crysin" (the so-called "gold cure" of tuberculosis), and in industrial hygiene, the latter including research on the manufacture and use of tetraethyl lead, an ingredient used in "high-power" gasolines. Of particular interest are the tests of material for use in the treatment of scarlet fever, as these have to be performed on human beings, animals not being suitable for these experiments.

An office has been established for the purpose of supplying health officials with information on current practices in their line of work. This endeavor is allied with the continued study of municipal health department activities.

The Public Health Service has continued to supply medical attendance and services of various kinds to the United States Coast

Guard, Employees' Compensation Commission, Civil Service Commission, Bureau of Pensions, Lighthouse Service, Shipping Board, Steamboat Inspection Service, Veterans' Bureau, Mississippi River Commission, Bureau of Immigration, and the Prohibition Unit. The number of merchant seamen, the principal beneficiaries treated, exceeded that of any previous year, as did the total amount of all relief furnished. It costs the Public Health Service $3.80 per day to care for each patient in hospital, as compared with $4.08 in 1923.

The National Leper Home at Carville, La., cares for 259 patients, while about 400 tuberculous seamen are treated in the marine hospitals at Fort Stanton, N. Mex.

The campaign for the control of venereal diseases was continued along the lines of the threefold plan of (1) educational measures, (2) legal measures, and (3) medical measures. In the field of legal measures, progress has been very satisfactory. It is also gratifying to note that many State boards of health now have a permanent program of venereal-disease measures incorporated with their other public-health activities.

Interesting figures furnished by the Bureau of the Census are given on institutional care and custody in the United States. During 1922, the last year for which data are available, there were 78,070 persons cared for in almshouses and 348,174 persons treated in hospitals and like institutions for the insane, the feeble-minded, and epileptics, while records show that 400,000 persons go out from State and Federal penitentiaries annually. The Surgeon General invites attention to the fact that many of the inmates of the almshouses and institutions for the insane and feeble-minded are in those institutions as a result of preventable disease.

SANITARY PROGRESS IN HAITI

Elsewhere in this number of the Bulletin there appears a most interesting article by Commander C. S. Butler, Medical Corps, United States Navy, on "The medical needs of the Republic of Haiti at the present time." This describes in some detail the progress that has been made since 1915 by naval medical officers in improving sanitary conditions in Haiti.

Commander Butler is sanitary engineer, in charge of Service National d'Hygiene Publique d'Haiti. In connection with his paper, it might be of value to those of our readers who are contemplating duty in Haiti or other tropical islands to note the accomplishments of this service for the year 1925. These are given in the annual report of the sanitary engineer for 1925, which has just been received.

A summary of the accomplishments as given in the report follows:

1. The reorganization of the service under five divisions—sanitation, quarantine, hospitals, supplies, and finance—has been continued and further elaborated.

2. Sufficient additional United States naval personnel has been secured to make it possible to place at least 1 commissioned officer and 1 enlisted man in each of the 10 public health districts, an increase of 7 over the number employed last year and a total of 36 on duty with this service at the present time.

3. The enactment of a law authorizing the President of Haiti to commission Haitian physicians as public health officers in this service in six classes. To date 13 physicians have been commissioned.

4. Continuation of the employment of recent graduates as internes in the larger hospitals, three having finished the one-year term and three others having been employed.

5. Government ownership of all institutions operated by this service.

6. The following laws submitted for enactment:
   (a) Revision of the national quarantine law.
   (b) Revision of the section of sanitary rules and regulations relating to the reporting of certain diseases.
   (c) A law requiring the licensing of all dogs.
   (d) An immigration law.

7. Plans drawn for a quarantine station.

8. The international health board of the Rockefeller Foundation continued a medical survey of Haiti during the past year.

9. System of medical inspection of school children started. Treatment where indicated.

10. Vaccination of unprotected school children.

11. Sixteen rural dispensaries completed or in process of erection.

12. Extensive expansion of rural clinics throughout the Republic.

13. Reorganization of the curriculum of the National Medical School and request for credit of 100,000 gourdes for a new school.

14. Substitution of bismuth preparations for the more expensive arsenicals in the treatment of treponematosis with consequent expansion of this most important work.

15. Gradual substitution of motor transportation for less efficient methods of collecting refuse.

16. Extension of simple sanitary measures to many of the smaller communes.

17. Systematic expansion of all hospitals.

18. Development of laboratory facilities.

In addition, Cape Haitien reports a considerable reduction in the incidence of malaria among the United States marines, as a result of a campaign of filling, draining, and oiling; completion of an operating pavilion, with X ray, eye, ear, nose and throat department, and dental rooms in connection with the hospital; also laboratory, morgue, and autopsy rooms. A surgical ward, given by the American Red Cross, has been completed and is in operation, and the main building has been renovated.

Cayes reports that 4,500 school children have been vaccinated during the year, and that construction of the new 200-bed hospital is well under way.

At Hinche a new public health hospital of 100 beds has been opened.

Construction of a dispensary and isolation ward has been started at Jacmel.

Equipment of the hospital at Jeremie has been completed.

In Port au Prince the beginning of a water-carriage sewage system has been made, and extensive improvements to the hospitals have been completed or are under way.

Other districts report progress, especially in the hospital situation.

THE CAUSE OF ENCEPHALITIS LETHARGICA

The Science News section of Science (LXII; 1612; November 20, 1925) makes note of a discovery of much interest and importance. If confirmed by other research workers, the isolation and identification, by Miss Alice C. Evans, of the Hygienic Laboratory of the United States Public Health Service, of the organism that produces *encephalitis lethargica* will be of far-reaching benefit.

The organism described by Miss Evans belongs to the streptococcus group and varies greatly in size. At times, it is so small as to pass through the finest filter, while, at other times, it is large enough to be seen with the microscope.

The streptococci with which Miss Evans conducted her experiments were obtained from the brain of a patient at St. Elizabeths Hospital who had died of encephalitis. They were cultivated in test tubes and used to inoculate rabbits, the results seeming to prove that the real cause of this modern malady has been found. The rabbits inoculated contracted the disease and, after death, large numbers of the same organism were found in their brains. These, when given to other rabbits, produced the disease through a series of 17 generations of the germs.

Miss Evans found that the bacteria lose virulence when kept for a long time. She also noted that small doses of the virulent organism, when injected into rabbits, gave rise to a partial immunity.

Encephalitis lethargica has become a not uncommon disease, and seems to be distinctly upon the increase. Hence, anything that throws light upon its cause, thus rendering it more likely that a cure will be found, is of great value.

MERCUROCHROME IN ERYSIPELAS

W. W. Eldridge, in Annals of Clinical Medicine (IV; 4; October, 1925) reports the results of treating a small series of cases of erysipelas at St. Elizabeths Hospital. Although the series was too small to warrant any very definite conclusions as to the value of mercurochrome, locally, in this condition, the results were so good as to make desirable further trial of the remedy.

Eleven cases of erysipelas were treated, three by the older methods of using cold compresses—in one case magnesium sulphate solution being added—and eight by the local application of 5 per cent mercurochrome solution.

The solution was "applied to the affected area with cotton swabs, once daily, until the eruption was well on its way toward subsidence. In only one case did the affected area show any tendency to spread after the first application of the drug, and in this there was no spreading after the second application. * * *"

In all cases treatment was started on the first day of the eruption.

The treatment of the three cases by the older methods was done for purposes of comparison. Two of these developed serious complications—one died—and all showed a tendency for the eruption to spread.

The most striking feature brought out was the difference in the length of time required for the fever and the eruption to subside under the two methods of treatment. In the cases treated by the older methods, this was, respectively, 11.3 and 13 days, while, in those treated with mercurochrome, only 7.5 and 6.4 days were required.

While erysipèlas is no longer regarded with the dread which formerly attended it, and no deaths were attributed to it in 1925 in the Navy, it was the cause of 614 sick days, an average of 22.7 days per case. If this average can be reduced to 6 days, considerable saving will result to the Navy. At any rate, the method is worth a trial.

U. S. P. X. CHANGES

At the request of the chairman, Committee on Revision of the Pharmacopœia of the United States of America, 1920–1930, the following notice is published:

It has been found necessary to make the following changes in the United States Pharmacopœia, Tenth Revision. These alterations have been made in the plates so that recent printings need not be corrected.

Acidum sulphuricum aromaticum (*p. 27*).—Add the following statement: "Alcohol content, by volume, 82 to 85 per cent."

Aethylmorphinae hydrochloridum (*p. 37*).—Change the second test for identity to read: "Add a drop of ferric chloride T. S. to a solution of about 0.01 gm. of the salt in 10 c. c. of sulphuric acid, and warm it on a water bath; the mixture will become at first green, then deep-violet blue, and, after the addition of a drop of nitric acid, deep red."

Benzoinum (*p. 78*).—Change the last test for identity to read: "Treat about 1 gm. of powdered benzoin with 15 c. c. of warm carbon disulphide, filter, wash the filter with an additional 5 c. c of carbon disulphide, and allow the filtrate to evaporate spontaneously; the residue is not less than 12.5 per cent. This residue responds to the tests for identity under *Acidum benzoicum*.

Bismuthi subnitras (*p. 81*).—Change the first test for purity to read: "Boil 1 gm. of Bismuth subnitrate with 20 c. c. of a mixture of equal volumes of acetic acid and distilled water. Cool and filter. Add 2 c. c. of hydrochloric acid, remove the bismuth by the addition of hydrogen sulphide, boil the mixture, and filter; the filtrate leaves not more than 0.005 gm. of residue on evaporation and gentle ignition (*zinc, alkali earths, or alkalies*)."

Codeinæ sulphas (*p. 115*).—Change the third test for purity to read: "A solution of 0.5 gm. of codeine sulphate in 15 c. c. of distilled water requires not more than 0.3 c. c. of fiftieth-normal sodium hydroxide for neutralization, using one drop of methyl red T. S. as indicator."

Collodium (*p. 118*).—Add the following statement: "Alcohol content, by volume, 22 to 24 per cent."

Collodium Flexile (*p. 118*).—Add the following statement: "Alcohol content, by volume, 21 to 23 per cent."

Fluidextractum cinchonæ (*p. 165*).—In the menstruum the "100 c. c. of hydrochloric acid" should be "100 c. c. of *diluted* hydrochloric acid."

Glycerinum (*p. 180*).—In the last test on page 180 the amount of glycerin to be used for the test should be *50 gm.*, not "50 c. c."

Infusum digitalis (*p. 197*).—Add the following statement: "Alcohol content, by volume, 8.5 to 9.5 per cent."

Linimentum chloroformi (*p. 204*).—Add the following statement: "Alcohol content, by volume, 43 to 47 per cent."

Linimentum saponis (*p. 205*).—Add the following statement: "Alcohol content, by volume, 62 to 66 per cent."

Linimentum saponis mollis (*p. 205*).—Add the following statement: "Alcohol content, by volume, 28 to 32 per cent."

Liquor ferri et ammonii acetatis (*p. 214*).—Add the following statement: "Alcohol content, by volume, 4 to 6 per cent."

Liquor potassii arsenitis (*p. 222*).—Add the following statement: "Alcohol content, by volume, 1 to 3 per cent."

Mistura glycyrrhiza composita (*p. 241*).—Add the following statement: "Alcohol content, by volume, 9 to 11 per cent."

Oleum cari (*p. 253*).—The refractive index should read: "1.4840 to 1.4880 at 20° C."

Talcum purificatium (*p. 379*).—The "Note" should read: "Purified talc is intended only as a filtering medium and for this purpose should not be finer than the powder which passes through a No. 80 sieve but is retained by a No. 100 sieve."

THE GREATEST BENEFIT MEDICAL OFFICERS CAN CONFER UPON THE SERVICE

While the bureau is desirous of allowing as many well-qualified medical officers as possible to take special courses in surgery, internal medicine, and other specialties, in order that they may become more valuable to the service, it is but natural that the time should come when it will be impossible to divert more officers from hospitals, ships, or other stations without crippling the medical activities at these places. With this in mind the bureau wishes to impress upon commanding officers and those fortunate ones who have received the benefits of special training and have become recognized

as leaders in their special lines of work, that, while their ability in surgical technique, diagnosis, treatment of disease, or administration, is of great value to the service, the way in which they may prove of greatest value, and justify the bureau in continuing its educational policy, is by developing successors to carry on the same high grade of work that they have been doing as a result of their special training. In other words, the one who has been taught should teach. He should not be satisfied to keep to himself all the knowledge gained, but should pass it on to others. By so doing, he will be making to the Navy the utmost return for favors received.

FAT-FREE TINCTURE OF DIGITALIS

Medical officers who prefer fat-free preparations of digitalis will be pleased to note that tincture of digitalis, U. S. P. X., is fat free. It will no longer be necessary to obtain the fat-free tincture on open purchase requisition, as the medical supply depots will be governed by the new pharmacopœial requirements in making purchases.

WANTED—MEDICAL ITEMS OF HISTORICAL INTEREST

For many years the National Museum in Washington has had an exhibit dealing with materia medica in all its phases. Recently the curator of this division of the museum has been expanding the scope of the exhibit to include all medical or surgical items of historical interest found in this or other countries. The exhibit was formerly under the charge of naval medical officers—among them the late Medical Director James M. Flint, the late Medical Director Henry G. Beyer, and Medical Director John C. Boyd, retired—but, more recently, it has assumed such proportions as to require the services of a full-time curator. The present curator is anxious to enlarge the exhibit still further by the addition of any medicinal plants, surgical instruments or appliances, books, or, in fact, anything unusual or of historical interest.

Naval medical officers, who should take a very real interest in this exhibit because of the association therewith of former members of their corps, if for no other reason, will render a service of lasting benefit to the museum and to medicine, if, in their travels to foreign lands or to the island possessions of the United States, they will be on the lookout for such items, and will forward any they may obtain to the Curator, Materia Medica Division, National Museum, Washington, D. C. They may rest assured that any such gifts will be gratefully received.

RECENT DEVELOPMENTS IN NURSING EDUCATION[1]

By Mary May Pickering, R. N.

It is good for us occasionally to turn aside from our routine plodding to look around us to see what others are doing, to scan the road over which we have traveled, and to peer ahead, if may be, into the future. Future possibilities in nursing challenge our minds and our spirits. These possibilities are doubly interesting if we study them in connection with the conditions in the past that have influenced nursing and nursing education. I should like to review with you some of the milestones we have passed in our 50 years of progress.

Those early schools—how far removed from the ones we know to-day. In selecting a part of the hospital for the first year's try out of a school established in 1873, a certain building was chosen not only because it contained both medical and surgical patients, but, to quote from the committee's report, "because it offers the hard labor desirable for the training of a nurse." In her "Reminiscences," Linda Richards writes: "We arose at 5.30 a. m. and left the wards at 9 p. m. to go to our beds, which were in little rooms between the wards. Each nurse took care of her ward of six patients both day and night." The nurses repaired the linen in their time off duty; occasionally they washed and ironed it, in order to have enough for the beds; they carried soiled linen to the laundry, washed dishes, swept and mopped the wards, carried food and medicine, ice, and milk to the wards—anything and everything that needed to be done.

Students were accepted singly as "probationers" when it was convenient; placed on the wards and taught by the head nurses; all who could be spared from their work were sent to a weekly lecture given to the whole school; during their second year in the school they were sent into homes on private cases—for which the hospital received the money and the students the experience. Students were "graduated" at the end of two years with as little ceremony as at their entrance.

Offered as it was, as one of two kinds of work (aside from marriage) open to women, it is not surprising that the new profession

[1] Presented at the convention of the California State Nurses' Association in Santa Cruz. Reprinted from the Pacific Coast Journal of Nursing for August, 1925.

attracted women of refinement and education and very exceptional ability. These women—mature, self-sacrificing—gave a type of loyal service to the hospitals that we rarely expect to find now. An early graduate writes:

We realized early in our training that many things we had to do had little relation to nursing. We took the training as a fundamental, not an incidental occupation, and though the incidentals were many and grievous, we saw the opportunity to get what we were after. Added to their individual character development is the fact (sometimes overlooked, especially by our critics who compare our students to-day with those they knew in the "good old days") that they were skilled housekeepers, and many of them experienced school-teachers. To these early graduates we owe the driving impulse that established nursing as a profession, and to their successors the vision and dogged perseverance that have carried it to its present development. We pay homage to Linda Richards, Isabel McIsaacs, Lucy Drown, Isabel Hampton, Sophia Palmer, and to Anna G. Maxwell, M. Adelaide Nutting, Mary Riddle, and Annie Goodrich.

Twenty years after the establishment of these first training schools some of their superintendents met together and organized the society which later became the National League of Nursing Education. At their first meeting these were some of the problems discussed: What subjects should be taught in the curriculum, how to standardize the teaching, how to make the students' experience more valuable, how to get away from the economic necessity of providing nursing care for hospital patients to the point of exploiting the students. (They have a familiar sound, do they not?)

We can understand many of the problems that exist in the nursing profession and schools of nursing to-day, as well as the inability of our professional leaders to cope with these problems if we take into consideration four factors. First, that the increase in numbers of nursing schools has been phenomenal. Listen to these figures:

	Schools
1873	4
1883	22
1900	400
1910	1,100
1920	1,800

The census of 1920 listed 150,000 graduate nurses in the United States, and it is estimated that they are increasing at the rate of 15,000 yearly.

Beside this abnormal growth place the second factor, that every school was organized in connection with a hospital primarily because of the economic need of the hospital for inexpensive nursing service. The opening of a new hospital presupposed a school of nursing to nurse the patients. As the increase in hospitals for the past 20 years has averaged about 70 per year, how could they have obtained enough nurses for the patients except by training them under their

own roof? Is it to be wondered at that they unconsciously shaped the education of the nurse so that she gave them a maximum of labor? Miss Nutting has put it very well when she said: "Our educational system was built up *within or after* the day's labor."

The third factor is the inevitable shortage of properly qualified women to conduct these schools. How would it have been possible (our educational system being what it is), to find among the graduate nurses of this country an expert administrator and well-prepared educator to organize 70 schools per year—a new one on the average every five days?

Fourth, the constant development of professions open to women has seriously affected our source of supply. Instead of choosing between marriage, teaching, and nursing, the young woman of to-day may select any one of 600 occupations, most of which require shorter preparation and less sacrifice of self than nursing.

Combining these four factors—the abnormal growth in numbers of schools, their establishment on an economic rather than an educational basis, the dearth of well-prepared educators, the opening of other professions in large numbers—we produce some of the problems that have influenced our development. Their magnitude, instead of overwhelming the women engaged in educating nurses, served to stimulate them to a more determined effort to overcome and surmount them. Through the years the League of Nursing Education has been largely the instrument of its progress. May I sketch for you some of the outstanding events in that progress?

In 1896 the course was lengthened to three years, with the plan that the working-day would be shortened to eight hours and the third year used for additional experience and study. A few years later the preliminary course was started. In 1903 the first registration was established. In 1907 a course in hospital economics was inaugurated in Columbia University, the first time in history that a university opened its doors to nurses as nurses. In 1910 the first university school of nursing was established in Minnesota.

The League of Nursing Education had long felt that if a study of existing conditions in nursing schools could be made it would result in definite reforms. In 1911 it began to seek funds for such a survey; but it was not until eight years later that the Rockfeller Foundation undertook the work, and after three years of investigation published in 1923 the Winslow-Goldmark report, with which we are familiar.

In 1917 the league published the Standard Curriculum for Schools of Nursing, the result of three years of labor, correspondence, and committee work on the part of nursing educators. To say that this curriculum has greatly improved our courses is putting it very mildly. Since the publication of the Winslow-Goldmark report

it has been revised and is appearing month by month in the American Journal of Nursing. It has been only 15 years since it began to be customary to employ graduate nurse instructors for the nursing school. The growth and improvement in this respect has been universal.

In 1920 the league began to work for money to classify and grade schools of nursing, and only in the past two months their dream has been realized to this extent—that money has been appropriated to begin it and a committee of doctors, nurses, and other educators is working out plans.

Of all these events, the Winslow-Goldmark survey is the most important, as it has shown precisely, impartially, and impersonally just what is wrong with nursing education. That the committee's findings agree with and emphasize facts and remedies that for years have been stressed by nursing educators is gratifying though not surprising. From the point of view of standardization and stabilization of nursing education this grading project will be even more important. While no school will be graded except by its own request, can we not expect that every school will ask to be included? To be willing to have an impartial outside agency examine the child of our heart, imperfect as we know it to be, will require on our part a deep and sincere desire to do this thing that will mean most to the mental and physical health of the world in the way of providing adequate education for its nurses. I believe that each of us may expect our hospital to make every effort to satisfy the standards for an accredited school—not only to assure applicants but because it has a genuine pride and interest in its students and their education.

These are some of the high lights of progress created by the combined efforts of our national organizations. That the awakening is general through the whole nursing group is evidenced in many ways throughout the United States.

In the schools of nursing conditions have changed to a marked degree—comfortable students' dormitories, shorter hours of duty, proper attention to nutrition, physical condition, and recreation. Student nursing service has been supplemented by graduate nurses and by attendants. Classrooms, even education buildings, have been provided. Textbooks have increased from Miss Nightingale's immortal "Notes on Nursing" to scores of excellent books, many of which were written by nurses. Well-prepared instructors have introduced better teaching methods; there is a concerted effort to correlate class and practice work, even to the extent in some schools of alternating periods of class work with periods of practice work.

Furthermore, it is becoming more common to send students away from the parent school for experience in those branches of nursing in which the school is lacking—particularly in nursing of children, communicable disease, tuberculosis, and mental nursing, which are just beginning to be recognized as essential parts of the nurse's education.

Many schools have been established with a university affiliation. Centralized instruction is very commonly used—in Philadelphia, Grand Rapids, Westchester County, N. Y., Kansas City, District of Columbia, etc. Actual consolidation of schools has rarely taken place. In Minneapolis four schools have merged to make up the University of Minnesota School of Nursing, and in Cleveland three schools have combined in the Western Reserve School of Nursing.

The establishment of the School of Nursing in the Western Reserve University on the basis of a $500,000 endowment and the opening of the new school at Yale financed by the Rockefeller Foundation as an experiment in nursing education are well known to all of us. And just this week comes the announcement that the Foundation has given $100,000 to Vanderbilt University in Nashville for a department of nursing.

In less than three years we see three schools of nursing established on an independent financial basis. Simultaneously with the establishment of this last school, a bill has been passed in California founding a chair of nursing education in the University of California, for the purpose of preparing graduate nurses for administration and teaching in the schools of nursing. The establishment of this professorship is an event of as great importance to the profession as was that at Columbia University 18 years ago. The day is not far distant when it will be no longer necessary for a graduate nurse in California, who wishes to prepare herself for teaching and administration, to take a trip of 3,000 miles to New York City to get that preparation.

Nor is the interest in the new education confined to schools and colleges; in the big centers everywhere institutes are being held, some for 2 or 3 days, the more ambitious for a period of 10 days to 2 weeks. They deal with many problems—from nursing technic to how to speak effectively in public. Without exception they report enthusiastic interest and attendance on the part of graduate nurses.

What is the keynote of this new education? Simply that the nurse must be prepared to fulfill her function in the community and not solely to meet the needs of the hospital with which her school is connected; that she must learn to care for her patient as an individual who is a part of a community—not merely as an

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appendectomy or a pneumonia or that patient of Doctor So-and-So's. In the May number of the American Journal of Nursing, Miss Goodrich has published a chart showing the Yale Organization. She also states succinctly the aim of the new education—"Not only that the principles of public health shall be included in the basic preparation of every nurse, but that *they shall be the bedrock on which the principles and practice of curative nursing rest.*"

We need not be reminded that the nurse needs this social viewpoint if she is going to play the part expected of her in the prevention of disease. The revised standard curriculum is planned around an ideal of positive health and emphasizes the social and human side of the nurse's work. We are told that this should guide all our work, not only in formal instruction in the classroom, but in the hospital wards. This sentence from a recent article indicates the change in point of view here: "Supervision is spiritual leadership."

In our zeal to broaden the nurse's education there is grave danger that we will forget that training in bedside nursing is after all essential. As Isabel Stewart said, "The art of nursing is the ground floor of our structure." The new social emphasis must not minimize the necessity for producing "good nurses" in the old sense of the word.

There are other problems that we will have to solve. They may not be strictly educational problems, but they should be considered in connection with them. The first is the provision of adequate nursing service for the community at a cost that the community can afford to pay. And the second is the training and regulation of the attendant or nurse's aid. We have had demonstrated in our hospital wards that the attendant can do many things for the patient under the nurse's guidance, and we know that many chronic or convalescent patients could be cared for solely by the attendant in the home or the chronic hospital.

Ignoring the existence of this problem does not remove it. That it does exist is proven by the last census, which showed that there were as many untrained nurses in the field as graduates—150,000. They will practice; people will employ them. For the safety of our communities why should we not undertake to plan courses for them and regulate their practice by law?

The other problem—the provision of adequate nursing service for the community—is being widely discussed, sometimes with acrimonious comments on the nursing profession. Why should we not, as a united nursing group, study this problem from every angle, find out about the various plans for Visiting Nurses' Associations that will serve the people who are able to pay as well as those who can not pay, investigate the possibility of the establishment of group

nursing more commonly in our hospitals? Why should we not see to it that the nurse should graduate from her training school, taking it as a matter of course that giving care to several patients—"general duty," so called—is an occupation just as honorable and as deserving of respect as *staying with* (note I do not say *nursing*) one patient for 12 or 24 hours. If we could work out this problem we would not only be giving better service to the public, but we would as well obtain a reasonable working-day for the nurse at a proper rate of pay.

We have discussed the beginning of nurse education in the United States; outlined some of the conditions that have influenced its development; namely, the abnormal growth in the number of schools, their establishment on an economic rather than an educational basis, the shortage of well-prepared teachers and administrators, the change in supply of applicants.

We have traced some of the outstanding accomplishments in our growth, more particularly the recent general awakening of interest in nursing education, the establishment of schools with independent financial backing, and the change of emphasis in the curriculum from training for the care of physical illness to an education that should adequately prepare the nurse for community work.

We have stated two problems that we believe the nursing profession, if it fulfills its highest obligations, should solve—the training and regulation of the attendant and the provision of good nursing care for all who need it.

In conclusion, may I quote from an address which Miss Nutting gave at the annual convention of the National League in 1923:

"Our golden age is not in the past, it is in the future, and the best inheritance we can carry over from the past is the spirit which has brought us through these difficult years, with undiminished courage and unshaken faith in the beliefs and principles for which we have striven. That spirit leads one to seek ever a better way, leads one to question, to grope for the right solution to the difficult problem. Following where it leads, one may falter, may fail, if need be, but the spirit which giveth life, survives error, survives even failure. It alone leads to progress."

EXCERPTS FROM LETTERS WRITTEN BY THE CHIEF NURSE OF THE U. S. S. "RELIEF" DURING THE TRIP TO AUSTRALIA AND NEW ZEALAND

During the recent cruises of the fleet to Australia and New Zealand, the nurses aboard the U. S. S. *Relief* were shown every courtesy and attention by the officials of these countries, also by the women of their own profession. In return, the nurses from

the *Relief* were very proud to have the opportunity of showing to others the convenient and up-to-date hospital afloat with the fleet.

Excerpts from the chief nurse's letters will be of interest to readers of the BULLETIN. After leaving Sydney, she wrote:

"There is one person to whom we owe much, directly, and perhaps, indirectly, everything. She is Miss E. P. Evans, secretary of the Australian Nurses' Association. It was through her that all Sydney knew we were with the fleet and it was through her that many people were particularly thoughtful and hospitable to us. * * * I want to tell you just a little of her difficulties in finding out positively that there were nurses with the fleet. At first she heard a rumor and immediately went to our American Consul, Mr. Lawton, for the facts, but he knew nothing about it and could not help her out. Later at a Chamber of Commerce dinner, Doctor Stephens, an Australian, who had been in Honolulu while we were there, mentioned in his speech that there were nurses aboard the hospital ship, but that the *Relief* was going to Melbourne instead of to Sydney. So Miss Evans had the fleet committee radio the commander in chief of the fleet and the reply came that the *Relief* was going to Sydney and there were seven nurses aboard. Doctor Stephens corrected this, for he knew definitely there were 12. Miss Evans made every possible effort to have the officers of the association be among the first to come aboard to welcome us. This could not be granted them, so a note with a tentative program came almost as soon as the anchor went down.

"It was a matter of interest to find there are over 6,000 members in the association, 2,000 in Sydney alone. The whole population of Australia is only 6,000,000. Before we arrived we were asked to make one day 'Doctors' Day' and one day 'Nurses' Day," and the general public was to be excluded on those days. It is estimated there were 1,200 nurses aboard on Nurses' Day. I am not exaggerating when I say I refused at least 100 invitations to tea that day alone. The program planned by the Australian Nurses' Association included teas and luncheons at different hospitals where we were shown through the hospitals, a garden party at the Government House, several dances, including the lord mayor's ball, and theater parties. At the Edith Cavell House, six rooms were reserved for the nurses during their entire stay in Sydney. On days that we were free, we shopped or had guests aboard trying in a small way to give some response to their hospitality. It was quite evident how much the profession here in Sydney—in fact, of all Australia—admires and tries to pattern after the American organizations and ideas.

"The last day in Sydney was like Christmas. There were being sent aboard books, flowers, candies, games, and favorite tea, until

we felt our home was not large enough to hold it all, and it was not large enough for the amount of flowers. At dinner time that evening, the messenger appeared with immense packages.

"The American Society sent each nurse a beautiful steamer rug for her remembrance of Sydney. The whole thing was a marvelous visit for everyone, I have not heard a single exception in the whole fleet. * * * To-morrow we see New Zealand. I think there are many aboard who are finding consolation in the thought that we are homeward bound."

After leaving New Zealand, the chief nurse wrote:

"In Sydney, as I wrote in my last letter, the Australian Nurses' Association had full charge of the program. They, and the people we met through them, were such charming people and all the entertainment was so pleasant and enjoyable. In New Zealand, our visit was just as pleasant and enjoyable, but of an entirely different type. The official entertainment committee of Australia included the members of the association in all their functions and likewise all the Government and State functions. But we saw none of that in New Zealand, yet were received more intimately by the higher government officials than even the officers.

"Our first day in Wellington we had many distinguished callers who came to invite us to the various functions. Among them was the lady mayor, the wives of two of the ministers, who would correspond to our Cabinet ladies, and Mrs. Mays, the wife of the United States vice consul. One of the invitations was for an afternoon in Parliament. This proved to be intensely interesting and pleasant. We sat in the section reserved for the ministers' wives and saw the formality of the opening of the session and remained to hear some of the discussions. In the midst of a discussion came a note to one of our hostesses from the Prime Minister, inviting her and her guests to his room to tea. We met several of the ministers there. They had to hurry back to their duties, but we had a lovely tea, after which we went through the whole building and saw all their treasures and relics. An interesting thing happened. They have the custom of autograph albums in Wellington. Some man in the Parliament building had one, and in their Maori room we had to sit in the old chief's chair and sign the book for him. He opened it at random for a sheet that had enough space for our signatures, and when we were finished called our attention to the fact that it was the same sheet on which the Prince of Wales had placed his signature. Later we saw that same book passed around among the members as they sat in session. As an outcome of that day, the Prime Minister sent us a note inviting us to the Trentham races on Friday and Saturday and to travel in the parliamentary carriage.

Part of the nurses went one day and the rest the next. It was indeed, a novel and pleasant experience, for had we been of the royalty, we would not have had more cordial hospitality.

"The lord and lady mayor's functions were of the usual type, perhaps a little more hospitable and friendly. There were two families who prided themselves on their gardens, Sir and Lady Rhodes and Sir and Lady Pomare. They took upon themselves the duty of keeping the nurses' quarters filled with flowers. But besides these there were countless bouquets sent in and our quarters were a regular flower garden all the time.

"Another very pleasant experience was our contact with the British naval officers. The flagship H. M. S. *Dunedin*, of the New Zealand division of the Royal Navy, was tied to the same dock as the *Relief*. It was a narrow dock, so that the lower ends of our gangways almost met. The officers were a group of splendid men, and the commodore was the best of all, and there was a beautiful spirit of friendship between the two ships. The nurses had tea with them one afternoon and they gave us the same honors upon going up the gangway as they gave our admiral, the marines lined up at attention and the commodore at the top of the gangway to give us the first salute. The evening before we sailed four officers, headed by their commanding officer, presented to the nurses a framed picture of the H. M. S. *Dunedin*. At the bottom is an engraved silver plate marked 'The Nurses of the U. S. S. *Relief*, from the Officers of the H. M. S. *Dunedin*, August, 1925.' The nurses are very proud of this remembrance of their visit to Wellington and their acquaintance with the officers of this ship of the Royal Navy.

"Our send-off the morning we left was most impressive and remarkably demonstrative for a British people. The whole ship's company was massed on the dock, the officers on the ship's deck directly behind them with the ship's band. Between pauses of Auld Lang Syne, the whole force would give three cheers for the *Relief*, and this continued as long as we could hear them.

"My mail was heavy with all sorts of letters. In one was inclosed 10 shillings, asking me to send a $2.50 gold piece as a souvenir of our visit. Another asking for the address of the mother of the sailor who died aboard, because she wanted to write to assure her that while her family lived in Wellington the boy's grave would be cared for. One letter asked me to give an opinion of the prognosis in a case of psoriasis on a 10-year-old child who had been troubled with it for four years. There were many letters inviting us to tea in the homes and many from clubs asking us to become honorary members during our stay, and accept the privileges of the members."

A VISIT TO THE LEWISHAM HOSPITAL AT SYDNEY, AUSTRALIA

By Carrie S. Albright, Nurse, United States Navy

Soon after our arrival in Sydney we were told that a visit to the Lewisham Hospital had been planned. One of the Mayo brothers of Rochester, Minn., visited the hospital several years ago, and in an article published in Sydney spoke very highly of it.

Miss Evans, secretary of the Australian Nurses' Association, and the nurses of the U. S. S. *Relief* were invited to luncheon. It was arranged for nine of us to go, and two large cars met us at the man-o'-war steps to take us to the hospital. The mother superior and several other sisters in flowing robes and veils of light blue cashmere welcomed us, and showed us to the reception room, where a very cheerful open fire greeted us chilly Americans. The mother superior took great pride in showing us framed photographs of distinguished visitors and patients who had been to the hospital. The sisters were women of the very highest type, and we were told that many were women of wealth and position who had come from England to devote their lives to their religious and hospital duties. Luncheon was soon served, to which only the guests sat down. The table was set with beautiful linen, silver, glass, and china, and was elaborately decorated. Several maids under the sisters' supervision served us a wonderful luncheon, and the champagne was of the best.

After luncheon the mother superior with several of the sisters went with us to a private mental hospital under the same order, and about 8 miles out of the city. This hospital consisted of long, low, red brick buildings set in very large, well-kept grounds, and accommodated 90 patients. The hallways, reception room, and patients' rooms were elaborately furnished and were immaculate. They were bright and cheerful and seemed homelike. Here we were served tea.

We then drove back to the Lewisham Hospital, and started our tour of observation. There were four large, three-story brick buildings—one for charity patients, another for patients able to pay, in which there were various small wards and some rooms, and another containing all private rooms. The fourth building was the outpatient department. There was little evidence of work going on, and everything was spotless, bright, and shining. The sisters do all the nursing of the patients, and a large staff of maids look after various other details. The wards were not very large, with beds fairly close together. There were some screened-in porches containing beds. The floors were polished, and everything was clean and in about perfect order. The operating and X-ray rooms were up to date and well arranged. In the semiprivate and private build-

ings there were good-sized rooms with large rugs on the floors, some large comfortable chairs, and three-fourth width beds with many pillows. The furnishings were more like those in a private home than are those usually found in hospitals. Everything looked as though it would be comfortable and pleasant for the patients, but a considerable amount of care to keep in such beautiful order. There were frescoes of flowers and birds around most of the rooms. The dishes, silver, and linen for the private trays were of the best.

We passed a small chapel in one of the buildings, and saw some of the sisters at their devotions. We were quite tired by the time we had been to all floors of the buildings, but enjoyed our visit very much, and decided it was a hospital to be proud of.

BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,
United States Naval Medical Bulletin,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.
(For review.)

MODERN MEDICINE, edited by *Sir William Osler, Bart., M. D., F. R. S.* Third edition, thoroughly revised. Re-edited by *Thomas McCrae, M. D., Professor of Medicine in the Jefferson Medical College, etc.,* assisted by *Elmer H. Funk, M. D., Assistant Professor of Medicine, Jefferson Medical College.* Volume II. Lea and Febiger, Philadelphia, 1925.

Volume II of Osler, as in earlier editions, deals with diseases of doubtful etiology; diseases caused by protozoa, spirochetes, and animal parasites; diseases due to physical, chemical, and organic agents; and deficiency diseases. It shows the same careful editing as does Volume I, and, like it, has been brought up to date to include all the newer knowledge of the diseases discussed.

Osler's monumental work is too well known to require extensive comment. This edition will in no way lower the opinion of students as to its value.

TEXTBOOK OF NERVOUS DISEASES by *Charles L. Dana, A. M., M. D., LL. D., Professor of Nervous Diseases in Cornell University Medical College, Consulting Physician to Bellevue Hospital, Neurologist to the Montefiore Hospital, Consulting Physician to the Manhattan State Hospital, ex-President of the American Neurological Association, ex-President of the New York Academy of Medicine, Corresponding Member of the Societe De Neurologie, etc.* Tenth edition. William Wood & Co., New York, 1925.

The original edition of this textbook was published 32 years ago, and it has undergone a general revision on 10 occasions to keep up with the advancement in our knowledge of neurology. The present edition covers the entire subject as it is to-day in an adequate manner. The book of some six hundred odd pages is compact for the amount of detailed information contained and the illustrations are clear and instructive. Three new chapters have been added. There is an introductory chapter on the History of Neurology by Fielding H. Garrison, A. B., M. D., lieutenant colonel, Medical Corps, United States Army, who is the highest authority on medical history in

this country. This is a very erudite, interesting, and educational story of the roots in the past from which neurology sprang and its development into a specialty. The next is a chapter on preventive neurology, presented here as a separate subject in a textbook for the first time. It was technically supervised by Dr. E. L. Corwin, secretary of the public health committee of the New York Academy of Medicine.

The other new chapter is one on epidemic lethargic encephalitis, written by Dr. Thomas K. Davis, who did important work on the subject in connection with its study by the Association for Research in Nervous and Mental Diseases.

This edition is recommended to naval medical officers as a very good text and reference book.

MEDICAL DIAGNOSIS, by *James M. Anders, M. D., Ph. D., LL. D., Professor of Medicine, Medico-Chirurgical College Graduate School of Medicine, University of Pennsylvania, etc.*, and *L. Napoleon Boston, A. M., M. D., Associate Professor of Medicine, Graduate School of Medicine, University of Pennsylvania, etc.* Third edition. W. B. Saunders Co., Philadelphia, 1925.

This new edition of Anders's well-known textbook contains all of great value that was contained in the earlier editions. The book has been brought up to date along all lines. In addition, the omission of case reports has made room for an elaboration of newer diagnostic methods and for a discussion of the diagnosis of the new diseases which have come into prominence since the second edition was issued. Like its predecessors, this edition will be used by thousands of students and practitioners with entire satisfaction and with the knowledge that it contains all the information necessary to enable one to arrive at a true diagnosis in most cases.

ALLERGY, Asthma, Hay Fever, Urticaria, and Allied Manifestations of Reaction, by *William W. Duke, Ph. B., M. D., Kansas City, Mo.* The C. V. Mosby Co., St. Louis, 1925.

The early chapters are devoted to a discussion of the theories concerning anaphylaxis, together with a historical review of the subject. The real value of the book lies in its later chapters, in which the author, himself a clinician of large experience in the treatment of cases of hay fever, asthma, and allied conditions, gives to others the benefit of his experience. He has written well and has made these little understood conditions as clear as possible. He shows the close relationship that exists between experimental anaphylaxis as produced in animals and the natural hypersensitiveness exhibited by certain persons—in many cases due to heredity—to various substances and in some cases even to physical agents, such as heat and light. Through study of a large number of patients the author has been able to demonstrate that certain disease conditions (achylia

gastrica, hypertension, and hypotension, etc.) are very common among the perennial sufferers from allergic reactions, while the chronic infections (tuberculosis, syphilis, etc.) are very rare among this class. The chapter devoted to a botanic survey of Kansas City is profusely illustrated and very interesting. The types of reactions and the symptoms are fully and ably discussed. The author warns against the common error of considering skin tests alone as being sufficient for diagnosis. In addition, the family and personal history, physical, laboratory, and X-ray examinations are required. The patient must observe carefully his own symptoms and the effect of adrenalin upon the symptoms must be noted. The final proof of diagnosis lies in the relief of the symptoms by removing the suspected cause and the return of the symptoms when the patient again comes in contact therewith. The various types of skin reaction and the methods of applying skin and other tests are well illustrated and described. Treatment is, first of all, removal of the cause. If this can not be accomplished, specific protein therapy is resorted to, or if the illness is severe enough to justify it and the cause can not quickly be determined, nonspecific protein therapy may be tried. Part II treats of reactions caused by physical agents and is most interesting. A complete bibliography is appended. Numerous evidences of careless proof reading mar the book, but do not destroy its value.

OCULAR THERAPEUTICS, by *Dr. Ernst Franke, A. O., Professor of Ophthalmology and Chief of the Second Eye Clinic at the University of Hamburg.* Translated by *Clarence Loeb, A. M., M. D., Oculist to the Michael Reese Hospital, Chicago.* The C. V. Mosby Co., St. Louis, 1925.

This book serves very well the purpose for which it was intended—namely, that of a compendium of information on remedies and drugs to which the busy eye specialist can turn for reference when he wants additional remedial hints in connection with the case he is treating.

The author has made the volume very condensed, and therefore has not been able to enter into any lengthy discussion of various drugs. The chapters are concisely and very well arranged for quick reference.

One aspect of the book that is to be admired is the broad view the author takes concerning the close association between general and eye diseases and the need for general treatment in connection with certain diseases of the eye. His chapter on tuberculosis is a very commendable one. He wanders a little out of his field in the chapter on syphilis, but the other chapters concerning ray therapy, electric therapy, heat and cold, and mechanical treatment are very good. The book is not, as the author says in his preface note, an encyclopedia, but a ready reference book.

A TEXTBOOK OF OPERATIVE ORTHOPEDICS, by *A. Steindler, M. D., F. A. C. S., Professor of Orthopedic Surgery, State University of Iowa.* D. Appleton Co., New York, 1925.

Formerly, there was very little orthopedic work done in most of our naval hospitals but since the war and the admission of many Veterans' Bureau patients, this branch of surgery has acquired greatly increased significance for us.

The ordinary textbook on orthopedic surgery devotes about half of its space to tuberculosis of the spine, congenital deformities, and the surgery of infantile paralysis, with which the Navy has little concern. Steindler's book is written not for the orthopedic specialist but for the general surgeon who is called upon to do orthopedic work. It appears to fill the need of naval surgeons in an almost ideal manner.

It covers tendon operations for relief of deformities, muscle plasties, fascial surgery, capsular surgery, orthopedic operations on bones, spinal surgery, joint surgery, surgery of the bursae, cinematization, nerve surgery, skin plasty and neoplasty, also principles of aftertreatment. The various operations are fully described and illustrated, also the indications and the author's conclusions as to their practical application are clearly stated. The illustrations are excellent, mostly in the shape of diagrams which show the essential features only, thus avoiding confusion.

This book will be a valuable addition to the libraries of naval hospitals.

ULTRA-VIOLET RAYS IN THE TREATMENT AND CURE OF DISEASE, by *Percy Hall, M. R. C. S. (England), L. R. C. P. (London).* With introductions by *Sir Henry Gauvain, M. A., M. D., M. C. (Cambridge), Medical Superintendent, Lord Mayor Treolar Cripples' Hospitals,* and *Leonard E. Hill, M. B. (London), F. R. S., Director Department of Applied Physiology and Hygiene, National Institute of Medical Research, London.* Introduction to American edition by *Edwin C. Ernst, M. D., F. A. C. R., F. A. C. P., Radiologist to St. Luke's Hospital, St. Louis, Consultant Radiologist to United States Marine Hospital, etc.* The C. V. Mosby Co., St. Louis, 1924.

This book is unusual in that it has three introductions, a preface, and three appendixes. The introductions contain the essence of the argument, of which the body of the book is an elaboration.

Civilization, with its clothes, brick walls, and clouds of smoke, constantly reduces the exposure of the body to the sunlight which is so essential to health. This book discusses the beneficial effects of the various rays emanating from the sun and their importance in health and disease. The various means of producing artificial sunlight, and especially the ultra-violet portion of the spectrum, are detailed and the methods of application are described.

It appears to the reviewer that some of the statements in the book rest upon a foundation that is none too firm and one looks in vain for discussion of the very important work recently done in

activation of avitaminous foods by the ultra-violet ray. However, in general, the subject is well handled and the book will be found useful to those handling chronic intestinal diseases and to those responsible for the public health.

OLD AND NEW VIEWPOINTS IN PSYCHOLOGY, by *Knight Dunlap, Professor of Experimental Psychology in the Johns Hopkins University.* The C. V. Mosby Co., St. Louis, 1925

This little volume contains three public lectures delivered at Johns Hopkins University and two public papers read before the Southern Society for Philosophy and Psychology. The book consists of about 150 pages and is divided into 5 chapters, treating, respectively, of the following topics: Mental measurements; present-day schools of psychology; psychological factors in spiritualism; the psychology of the comic; the reading of character from external signs.

The book, consisting as it does of a series of public lectures, makes interesting reading for anyone who may have a penchant for psychology. There is almost complete absence of the technical and sometimes desiccated language of the textbook.

The chapter on mental measurements discusses recent progress in intelligence testing. The author also rightly emphasizes the harm that may be done if these tests are applied indiscriminately by individuals with more zeal than training in this special work.

In speaking of the present-day schools of psychology, Professor Dunlap makes a plea for the development of psychology along well-balanced scientific lines and deplores the activities of extremists in the fields of behaviorism, Freudianism, etc.

Probably the most interesting and instructive chapter in the book deals with the psychology of the comic. Here the author discusses the psychological aspect of the comic situation and demonstrates that the comic can arise from only a comparatively few fundamental situations.

The other two chapters are obviously designed for use as material for public lecture and deal with the fallacies of spiritualism and the reading of character from external signs. Most of the argument is through the process of *reductio ad absurdum.*

ATLAS OF DISEASES OF THE SKIN, by *Prof. G. Riehl, Vienna,* and *Prof. Leo V. Zumbusch, Munich.* With diagnostic and therapeutic notes by *John B. Ludy, A. M., M. D., Col., Med. O. R. C., U. S. Army, Dermatologist to the Lankenau and Methodist Hospitals, Philadelphia; Assistant Dermatologist to the Pennsylvania, the Episcopal, and the Philadelphia General Hospitals, Philadelphia; etc.* In three volumes. P. Blakiston's Son & Co., Philadelphia, 1925

No review of this set of three books can do it justice; it must be seen to be appreciated, as it is to the visual sense it appeals most

strongly. The illustrations—of which there are 195—are all from actual natural color photographs of cases seen in the dermatological clinics of the authors and show the lesions as they appear to the observer. The text, by Doctor Ludy, is very concise and, taken alone, would hardly be considered sufficient in a textbook on skin diseases. In connection with the illustrations, however, it is all that could be desired. The error of describing many forms of treatment is avoided, only those forms which the writer has found best suited in his own practice being given.

Part I treats of Infectious Diseases of the Skin; Part II, of Inflammatory Diseases; and Part III, of Atrophies, New Formations, and Hypertrophies.

It is hard to see how anyone not entirely familiar with skin diseases will feel able to do without these books after once seeing them.

Radiography, a Manual of X-ray Technique, Interpretation and Therapy, *by Charles D. Enfield, M. D., F. A. C. P., Röntgenologist to St. Anthony's Hospital and Norton Memorial Infirmary, Louisville, Ky.* P. Blakiston's Son & Co., Philadelphia, 1925

The author evidently realises the difficulties which the medical man just beginning to take up X-ray work experiences in solving technical problems and in the interpretation of the evidence of common lesions. Such problems and the evidence of the everyday variety of lesions are but rarely discussed in medical journals and textbooks.

This manual contains many helpful points for the technician. It gives a comprehensive description of the old and new methods of interpretation together with the very latest changes in apparatus.

A helpful book in any library, it should be especially valuable to the medical man with little experience and who is not strictly speaking a röntgenologist.

Pitfalls of Surgery, by *Harold Burrows, C. B. E., M. B., B. S. (Lond.), F. R. C. S., Surgeon at the Gosport War Memorial Hospital; Late Consulting Surgeon to the British Expeditionary Force in France, etc.* Second edition. William Wood and Co., New York, 1925

It is unusual for a book based upon mistakes made by the author and others to be written. Such a book, however, is this by Burrows in which the author calls attention to mistakes that have been made, or might be made, in all branches of surgery in order that others, knowing them, may be saved from making these always distressing, and often disastrous, errors of diagnosis or treatment.

In the preface to the first edition, which appeared in 1922, the author likens the surgeon of to-day to the sailor of a past age who was forced to embark upon many uncharted seas. His aim in writ-

ing such a book is to locate some of the danger points in surgery. This, he accomplishes to a helpful degree.

The first pitfall mentioned is that of a "too cheery optimism," a fault of many surgeons, particularly of the less-experienced ones; while the main sources of error are given as ignorance, carelessness, misjudgment, and defective technique.

A careful reading of this book will be good for the soul of many.

THE RADIOLOGICAL EXAMINATION OF THE MALE URETHRA, by *G. L. S. Kohnstam, M. R. C. S. (Eng.), L. R. C. P. (Lond.), Late House Surgeon to the Urological Department, King's College, London;* and *E. H. P. Cave, M. B., B. S. (Lond.), M. R. C. S. (Eng.), L. R. C. P. (Lond.), D. M. R. E. (Camb.), Late Resident Radiologist, King's College Hospital, London.* William Wood and Company, New York, 1925

Radiologists have been zealous in their study of the genito-urinary tract, with the exception of the urethra. The urethra has received very little attention due to the fact that the genito-urinary surgeons have not realized how much real help might be obtained from properly taken radiographs of this region.

The technique as described by the authors is not difficult. The interpretation of the various shadows would seem to require considerable study and experience. This necessity for study and experience will probably limit the method described by the authors to urological institutions with a wealth of material from which to draw.

AN INTERMEDIATE TEXTBOOK OF PHYSIOLOGICAL CHEMISTRY, by *C. J. V. Pettibone, Ph. D., Associate Professor of Physiological Chemistry, Medical School, University of Minnesota.* Third edition. The C. V. Mosby Co., St. Louis, 1925.

This is an excellent intermediate textbook for the student of physiological chemistry. The writer wisely avoids lengthy discussions of debated points, and in a simple and lucid manner discusses the fundamental processes and compounds of importance in the animal body. As the modern tendency is to restrict the term physiological chemistry to that field of biochemistry dealing with animal material, the book may well be said to cover the essentials of that subject. The appended section on laboratory work is based on proved teaching methods in use at the University of Minnesota for the past five years.

AN INTRODUCTION TO OBJECTIVE PSYCHOPATHOLOGY, by *G. V. Hamilton, M. D., Director of Psychobiological Research, Bureau of Social Hygiene (Inc.), New York.* With foreword by *Robert M. Yerkes, Ph. D., LL. D., Professor of Psychology, Yale University.* The C. V. Mosby Co., St. Louis, 1925.

The author has had varied experience in institutional psychiatry, in private practice, in field studies of nervous cases, and in many

years of experimental studies of animal behavior, particularly that of monkeys. He does not belong to the Freudian school, but while giving them credit for their valuable contributions to our knowledge of the content of thought, he stresses the importance of behaviorism as a foundation for psychopathology.

In 1921 Doctor Hamilton spent one year in a small city in the Mississippi Valley, where the local physicians cooperated in referring their nervous cases to him for study. The book is divided into two parts. Part I is devoted to case histories and discussion thereof of 200 nervous cases studied at that time. "A nervous patient is one whose modes of response to various stimulations are of a kind to interfere with his comfort and efficiency." The author does not use familiar disease names, but classifies his patients according to the faulty mode of response presented by them; as persistent, nonadjustive, affective reaction to; baffling physical discomforts and disabilities; baffled effort to satisfy major cravings; baffling impairment of advantage to personal or impersonal agencies; baffling economic difficulties; and indirect reaction to sexual urges, to masturbation, etc. He states that one rarely encounters a patient who is unable to disclose by ordinary processes of recall ample material for an explanation of his nervousness. The general idea of the treatment is to explain their illness to them in terms of objectively formulated principles and to instruct them in more adequate and rational modes of response to their problem.

Part II contains a discussion of the results of his research in animal, child, and adult behavior and defends the principles of objective psychopathology as less speculative than psychoanalysis. There are chapters on reactions to baffling disadvantages, on habit formation, inhibition of responsiveness, unsatisfied major cravings, reactions of inferiority, and sexual behavior.

This book is recommended to all medical officers of the Navy. It is easy to read and will be found of decided interest and value in leading them to a fuller knowledge and appreciation of the nature and importance of nervous ills and of effective ways of managing them.

BAILEY'S TEXTBOOK OF HISTOLOGY, revised and rewritten by *Oliver S. Strong, A. M., Ph. D., Associate Professor of Neurology, College of Physicians and Surgeons, Columbia University*, and *Adolph Elwyn, A. M., Assistant Professor of Anatomy, College of Physicians and Surgeons, Columbia University*. Seventh edition. William Wood & Co., New York, 1925.

Bailey's Histology has been a standard textbook for many years, and this new edition, which has been extensively revised, rewritten, and expanded, maintains the high quality of the earlier editions.

A valuable feature is the emphasis given to the physiological, pathological, and clinical significance of the structures described,

which is in keeping with the modern tendency. One notices that the recent textbooks on anatomy, histology, physiology, and chemistry, instead of treating these as abstract sciences, devote more and more space to the exposition of their close relation to clinical facts. This increases the student's interest and helps to prepare his mind for better reception of the clinical teaching that is to follow.

There is a very complete chapter on histological technic. The illustrations are clear and the text concise. By means of a new process, the publishers have been able to reproduce photographs of Weigert preparations in such a way as to bring out the essential portions in an unusual manner.

A TEXTBOOK OF PHYSIOLOGY, by *William D. Zoethout, Ph. D., Professor of Physiology in the Chicago College of Dental Surgery (Loyola University) and in the Chicago Normal School of Physical Education.* Second edition. The C. V. Mosby Co., St. Louis, 1925.

Rather more advanced than the usual elementary physiology, this book would probably be very useful for hospital corps training schools and for the use of pharmacist's mates in naval hospitals.

The facts are stated in a clear and interesting manner, which makes the book easy to read and understand.

PHYSIOLOGICAL AND CLINICAL CHEMISTRY, by *William A. Pearson, Ph. C., Ph. D., M. D., Professor and Head of the Department of Chemistry, Physiological Chemistry and Toxicology,* and *Joseph S. Hepburn, A. M., B. S. in Chem., M. S., Ph. D., Associate Professor of Chemistry, Hahnemann Medical College and Hospital of Philadelphia.* Lea & Febiger, Philadelphia, 1925.

This new textbook is intended for the use of those who have already completed courses in inorganic chemistry, qualitative and quantitative analysis, physical chemistry, and organic chemistry. It therefore treats of these subjects very briefly, only that part of them which has a direct bearing upon medicine being given in detail.

Part I deals with physiological chemistry and gives and describes all the usual tests and procedures which are of value to the clinician and laboratory worker along this line. Chapters are devoted to the carbohydrates, the proteins, the enzymes, the tissues of the body, and foods.

Part II treats of clinical chemistry. In it may be found much of practical value to the physician. The subject headings of its various chapters are: Salivary and gastric digestion, intestinal digestion, feces, blood and cerebrospinal fluid, urine, milk, and water analysis. A short appendix contains directions for making many of the solutions used in the laboratory and gives a short but clear explanation of hydrogen-ion concentration. For convenience in making notes, blank pages are placed between each two pages of reading matter.

Muscular Activity, by *Archibald Vivian Hill, M. A., Sc. D., F. R. S., Professor of Physiology, University College, London.* The Williams & Wilkins Co., Baltimore, 1926.

The lectures delivered in 1924 at Johns Hopkins University on the Herter Foundation have been brought together and published in this book. They deal with the subject of muscular activity in several phases, as indicated by their titles: (1) The Dynamics of Muscular Activity, (2) The Heat Production of Muscle, (3) The Chemical Changes Accompanying Muscular Activity, and (4) The Recovery Process after Exercise in Man. As is to be expected, the lectures are highly technical in character and are not intended for popular reading. For the physiologist, they will add materially to his store of knowledge. Also, they will be helpful to those whose duties require them to direct the activities of athletes.

American Red Cross Text Book on Home Hygiene and Care of the Sick, by *Jane A. Delano, R. N., late chairman of the National Committee, Red Cross Nursing Service.* Third edition, revised and rewritten under supervision of the Director, Home Hygiene and Care of the Sick, American National Red Cross. P. Blakiston's Son & Co., Philadelphia, 1925.

This excellent and comprehensive textbook covers the subjects mentioned in its title in an admirable manner. The original text was written by the late Miss Delano in 1913. The second edition, revised by the late Anne H. Strong, R. N., appeared in 1917, in time to help thousands of women meet the emergency of home care of the sick during the influenza epidemic. This third edition has been made necessary by the expansion of the Red Cross course covering this field of work. It is the textbook used by the women and children taking the course and will meet their needs in every way. In it the preventive side of medicine is stressed, as it should be. A knowledge of the contents of this book will prove of real value to any woman or youth who may be called upon to care for the sick in the home, and an application of its rule of hygiene will go far toward reducing the necessity for such treatment.

Allen's Commercial Organic Analysis, Volume IV, edited by *Samuel S. Sadtler, S. B., Elbert C. Lathrop, A. B., Ph. D.*, and *C. Ainsworth Mitchell, M. A., F. I. C.* Fifth edition. P. Blakiston's Son & Co., Philadelphia, 1925.

This volume should prove a welcome addition to the reference library of the pharmaceutical chemist. The characteristics, constituents, and analysis of essential oils and resins are set forth in a comprehensive manner.

The chapter on rubber and allied substances, while primarily of interest to the chemist, may be read with profit by all who are interested in the rubber problems of to-day.

MEDICAL FORMULARY, by *E. Quin Thornton, M. D., Assistant Professor of Materia Medica in the Jefferson Medical College.* Twelfth edition, revised. Lea & Febiger, Philadelphia, 1925.

This revision of Thornton's well-known *Formulary* has been made necessary by the numerous changes which have been made in the United States Pharmacopœia, tenth. It contains only formulæ which have proved of value in the practice of the compiler or of others. The book will serve a useful purpose if it enables physicians to prescribe pharmacopœial drugs in palatable form, thus diminishing the use of proprietary and patent remedies which are so often prescribed because the patient finds them easy to take.

EYE, EAR, NOSE, AND THROAT MANUAL FOR NURSES, by *Roy H. Parkinson, M. D., Visiting Aurist and Oculist to St. Joseph's Hospital, San Francisco.* The C. V. Mosby Co., St. Louis, 1925.

The main part of the book is devoted to a discussion of anatomy, diagnosis, and treatment which would seem to be better suited to physicians than to nurses.

Chapter VIII, "Points in care and treatment of eye, ear, nose, and throat conditions," gives some good suggestions as to how the nurse may best assist the doctor, but contains little that is new.

On the whole, the book will be of little value to student nurses or to graduates.

SUBMUCOUS ENDOCAPSULAR TONSIL ENUCLEATIONS, by *Charles C. Miller, M. D.* The Oak Press, Chicago, 1925.

The writer of this book, if he is a member in good standing of any reputable medical society or has any hospital or teaching appointments, fails to mention the fact. The book itself gives the impression that it was written not to disseminate valuable knowledge to the medical profession so much as to attract attention to the author.

The special operation described by Doctor Miller is unusual, to say the least, and, as the question of the tonsil's possessing a distinct capsule is by no means settled, any so-called "endocapsular enucleation," it is believed, will not be favorably received by the profession.

The book will be of no value to naval medical officers.

THE DIVISION OF PREVENTIVE MEDICINE

Lieut. Commander J. R. Phelps, Medical Corps, United States Navy, in charge

Notes on Preventive Medicine for Medical Officers, United States Navy

THE NAVY RATION FROM THE VIEWPOINTS OF NUTRITIONAL SCIENCE AND PRACTICAL ADMINISTRATION

By J. R. Phelps, Lieutenant Commander, Medical Corps, United States Navy

Introduction

It is several years since an article dealing with the Navy ration from the viewpoint of naval hygiene has been prepared for possible reference use by medical officers of the Navy. The late Capt. James D. Gatewood, Medical Corps, United States Navy, in his book, "Naval Hygiene," published in 1909, devoted 115 pages in chapter 5 to a discussion of the Navy's food. He discussed the principles of scientific feeding as understood at that time in considerable detail. His common sense attitude and matter of fact conclusions regarding dietary needs and standards and practical ways and means of feeding the men of the Navy made that chapter very valuable to the medical officer who found time to study the article with sufficient care to inform himself thoroughly in the premises. Indeed, the chapter is well worth reading carefully to-day.

Nevertheless, much has been learned of nutritional needs since then. The term "well-balanced diet" has come to have a broader meaning than in the days when proteins were regarded as proteins pretty much regardless of the source from which derived, and when the idea of balance related principally to total fuel value and the proportion of proteins on the one hand and of fats and carbohydrates on the other as expressed by the "nutritive ratio." Since then much has been learned regarding the important rôle played by the inorganic elements in nutrition; much especially has been learned about calcium and phosphorus requirements, and, of course, it is now known that certain organic constituents must be included in the diet in at least optimum quantities as well as the nutrients, the proteins, fats, and carbohydrates, if diseased states are to be avoided, or, more broadly speaking, if the food consumed is to be compatible with good health throughout the life of the individual. There are, of course, the comparatively well differentiated factors, the so-called vitamins, fat soluble A, water soluble B, and the antiscorbutic factor,

now generally considered as vitamin C, also water soluble. Then there is the more recently determined antirachitic factor, now quite commonly spoken of as vitamin D, which is intimately connected in its action with the effects of sunlight or ultra-violet rays as given off by the mercury vapor lamp; and both the factor and ultra-violet rays seem to be concerned in the utilization of calcium in the animal body.

The vitamin may be deficient or lacking in the diet without causing injury provided the subject is living and working under such conditions that he is regularly exposed to direct sunlight or to the light from blue sky out of doors. It therefore appears that this vitamin is for practical purposes ultra-violet light, and for this reason, for purposes of public health education, cod-liver oil, which is known to contain vitamin D in relatively large amount, as well as the fat soluble vitamin A, has been called bottled sunlight.

Still more recently Goldberger and coworkers have discovered another dietary factor which if contained in the food will prevent and cure pellagra. This Goldberger has designated as the P. P. factor.

Much study is being devoted to the differentiation of still another factor which seems to bear specifically upon reproductive power—factor X or vitamin X.

Then, too, much has been learned about proteins. Proteins can no longer be considered as just protein—nitrogenous fuel and building material—for it is now known that proteins vary greatly in biological value—that is, in growth promoting value—according to the different amino acids that compose them and also according to the proportionate amounts of the more essential amino acids contained. Carrying the term balance down to the very protein or proteins in a single seed, cereal or legume, even if no single essential amino acid be totally lacking, as is the case with certain proteins of some seeds commonly used as foodstuff, the proportionate amounts may be such as to make utilization in the body less complete, so that apart from other biological considerations those proteins can not be regarded as taking the place of milk proteins, gram for gram, in the diet. In other words, if it be assumed for a given individual that all metabolic needs will just be met with as little as 60 grams of protein per day derived from milk, it by no means follows that 60 grams of mixed proteins of lower biological value will suffice.

E. V. McCollum and various coworkers have from time to time made valuable contributions through their research studies to the sum of what is known about nutritional needs in the maintenance of health and fertility, prolongation of life, and upholding of biological qualities in succeeding generations. McCollum's small and readable book, The Newer Knowledge of Nutrition, is doubtless familiar to the reader.

H. C. Sherman and others have shown that it is probably important that the diet shall be such as not unduly to tax the body in its efforts to maintain normal alkalinity of the blood plasma. Attention is thus focused on the ash constituents of the various foods which are ordinarily found in the diet with respect to whether the food is "acid forming" or "base forming" when metabolized. Although certain studies seem to show that the healthy animal body is extraordinarily capable of resisting efforts to overcome the normal hydrogen ion balance and bring about an acid condition, it by no means follows that it is not important to balance the diet as well as possible with regard to acid and alkali formation. Acidosis not infrequently occurs among human beings; sometimes under circumstances that are not at all understood. It is usually pointed out in this connection that most people on unrestricted diets naturally get into the habit of balancing acid-forming foods, such as meats, eggs, white bread, etc., with base-forming fruits and vegetables. For example, the orange at breakfast neutralizes the acid products from the bread, eggs, and lean part of the bacon. Potatoes likewise offset the egg or meat. Still in many households and institutions, with all meals considered, it would doubtless be found that acid-forming foods decidedly outweigh the fruits and certain vegetables which are the chief sources of alkaline bases. More of this later.

Whatever we may think about the value of different foods and regardless of any views we may hold as to the optimum quantity of food for different individuals under varying conditions of work and climate, certain practical considerations must take precedence in the purchase of foodstuffs, construction of menus, and preparation and serving of food in the general mess in the Navy, and particularly on board ship. Practically, the supply officer, with the aid of his assistants, must endeavor within the limits of the ration law and instructions of the Bureau of Supplies and Accounts to gain the reputation for the ship or station of feeding well. Unless the men are permitted to satisfy their appetites for food they will not be contented. Without general contentment there would be disaffection and consequently low morale. As Gatewood put it, the bluejacket is not a student of metabolism, but, on the other hand, is a follower of nature, and thus he lays great stress upon the meal hour. He has his labors to perform. As a mater of fact, contentment is impossible without work and good discipline is impossible without contentment.

Now, it may be from the viewpoint of some students of nutrition that the quantities of meats and proteins derived from meat products are too generously provided in the Navy ration. The answer to this and many other questions that are not without importance from the scientific standpoint is that the daily amounts of any and

all foods in the Navy ration as issued must depend essentially not upon what it is thought men ought to eat but upon what experience has demonstrated they desire to eat. To quote Gatewood once more, "The work of Chittenden emphasizes the value of temperance, but it is a moderation that can not be imposed generally upon men in naval life, as such a course would be distinctly in opposition to a naval policy that necessarily involves the encouragement of enlistments and the discouragement of desertions." The chef in a hotel has no power to dictate to the guests what they shall eat. The commissary officer in the Navy has no power to limit the quantity of food eaten by any individual in the general mess. There is a radical difference between prescribing diets for the sick and planning menus for healthy men who can not lawfully be compelled to subordinate their appetites to the current doctrines of science. They may however, to a certain extent be educated to select foods that are better for them, to cultivate a liking for certain foods they have considered distasteful, or, in other words, to eat more wisely while fully satisfying their appetites, and thus their preferences may, with a little educational effort, be modified so that the ration may be better balanced without provoking dissatisfaction and complaints. That is another question that will be dealt with in the following pages.

The Bureau of Supplies and Accounts feels that there should always be the closest possible cooperation between supply officers and medical officers in order that the crew may be fed in a satisfying manner and at the same time as scientifically as the manifestly generous and flexible Navy ration permits. And it is doubtless true that the medical officer who has a practical and up-to-date knowledge of the science of nutrition and at the same time is familiar with the ration law and the regulations and instructions designed for the guidance of supply officers can often be of assistance to the latter and make suggestions which will not only tend to promote contentment among the crew but will at the same time lead to improvement of the ration from the scientific viewpoint.

The object of the following article is to present for ready reference such information relative to the ration law and existing instructions, which must be followed by supply officers as the medical officer should have in mind when offering suggestions or making recommendations, and after that to discuss the more important principles involved in the science of nutrition as they may be brought to bear upon the question of feeding in the general mess. With these objects in view it is clear that some of the matter that follows will be found readable and some, notably tables, will be found useful to refer to only upon occasion in connection with some special problem, the attempt having been made to cull from standard works on nutrition sufficient data to fill most needs when reference works are not available.

The writer is indebted to Chief Pharmacist's Mate W. A. Washburn, United States Navy, an assistant in the Division of Preventive Medicine, for much labor and care in calculating fuel values, ratios between proteins, fats, and carbohydrates, calcium and phosphorus contents of foods, etc., as issued in the rations analyzed and studied in the course of preparing this article, and to Mrs. L. M. Anderson, of the division, for transcription.

The Ration Law

The existing ration law dates from 1906; that is, the provisions of law which now apply resulted from the act approved June 29, 1906, further amended by the naval appropriation act approved March 2, 1907, which succinctly provided that, "Any article comprised in the Navy ration may be issued in excess of the authorized quantity, provided there be an under-issue of the same value in some other article or articles."

It would be impossible to maintain contentment in the Navy now with the ration authorized prior to enactment of the 1906 law. Until 1898 the method of rationing was very imperfect as judged by present standards and practice. On board ship the crew was divided into many separate messes. Each mess elected one of its members caterer, as officers' and chief petty officers' messes now do. Certain foodstuffs having suitable keeping qualities, including dried and preserved foods and sea stores generally, were issued in kind to the various messes in quantities permitted by the ration law, and in addition each mess in proportion to the number of its members received a commuted ration allowance in money intended for the purchase of additional articles of food to supplement the food furnished by the Government in kind. Some messes lived pretty well, but at the same time and on board the same ship other messes might suffer badly as a result of ignorance, carelessness, or general inefficiency of the caterer, and not infrequently a mess would suffer the loss of its funds through the desertion of a dishonest caterer.

A great deal of the credit due those who brought about a radical change for the better in the system of feeding the enlisted men of the Navy and also secured the enactment of a better ration law, belongs to John S. Carpenter, now Rear Admiral John S. Carpenter, Supply Corps, United States Navy (retired). When he reported as pay officer of the U. S. S. *Texas*, January 1, 1898, he found that a general mess had been formed shortly before he joined the ship. So far as known, the experiment of feeding the enlisted men, exclusive of chief petty officers, in one general mess had not previously been tried in any ship. The plan of organizing and running the general mess resulted from the initiative and cooperative efforts of the executive officer, Lieut. Commander Daniel Delehanty, United

States Navy, and the pay officer, Paymaster Hiram E. Drury, United States Navy. Paymaster Carpenter, upon taking charge of this mess, at once saw the possibility of feeding the men better than many of them at least could expect to be fed under the system of separate messes. He kept an exact record of all foods used during the period of about three years he was in charge of the mess, and after detachment, in 1901, he invited the attention of the Paymaster General of the Navy to the inadequacy of the Navy ration as authorized by law at that time. He submitted a report covering his experience with the general mess on board the *Texas*, and the result was that a board was appointed in 1901 to consider the question of planning a better ration. The board accepted his data relating to articles of food, quantities, and equivalents, inasmuch as they represented actual experience in feeding the crew under varying conditions, including the time during which the United States was at war with Spain. Several years elapsed before the necessary legislation could be secured, but it may be said that the 1906 ration law was based directly upon the actual experience of administering the general mess of the U. S. S. *Texas*, 1898–1900.

In compliance with the writer's request, Admiral Carpenter kindly consented to sum up in the following memorandum the principal points connected with the drafting of the ration law which had previously been brought out in the course of conversation:

Formerly in the Navy the enlisted force was divided into separate messes, each mess choosing from its membership one man as caterer. The rations for the mess were issued to this man and the commuted ration money paid over to him for the purchase of additional articles of food. It was customary to give the mess caterer his own ration money as a perquisite. The result of this system was that the men lived very unequally. Some of the messes, such as the firemen's mess or the engineers' mess, having higher pay, contributed more liberally to supplement the Government ration. Then, too, the mess caterers varied in point of efficiency and it was not an infrequent occurrence for mess caterers to abscond with the ration money.

When I joined the U. S. S. *Texas*, January, 1898, I found that they had established for the first time in the Navy a general mess, including all enlisted men except the chief petty officers, and that the mess was administered by the pay officer of the ship, having as his principal assistant a chief yeoman. I took charge of the mess. We established a commissary store or canteen as it was then called. It was entirely unofficial but we kept for sale not only toilet articles, confections, etc., but also, in port, sold beer to the men. This canteen yielded a profit as I recall of about $600 a month which was used to supplement the Government ration, and all contributions by the members of the messes were prohibited. I kept an exact record of the food actually consumed, and it was generally admitted that the system of a single mess established on the *Texas* provided the best ration known to the service up to that time.

Upon my detachment from that ship I invited the attention of the Paymaster General, Admiral Kenny, to the inadequacy of the Navy ration and to the necessity of providing additional cooks, bakers, etc. Upon the recom-

mendation of Admiral Kenny a board was appointed to meet at Newport, R. I., to consider this subject. The board consisted of Captain Cottman, afterwards rear admiral, myself, and the medical officer whose name I do not now recall. As I had the actual data as to the food consumed on board the *Texas*, the board accepted my report, which I had previously drawn up for the information of the Paymaster General. The medical officer added certain statements as to the number of calories which would be included in the proposed ration.

The report of this board was approved and the necessary legislation obtained through the action of the Paymaster General, Admiral Kenny. The ration then provided for substantially what it does to-day, the principal addition being the provision for over and under issues. The proviso makes a more flexible ration, adaptable to climatic and market changes. For instance, in the Tropics we could give the men more fruit and less meat, etc. Under the old system the variety of food given to the men was very limited. When fresh meat was issued it was nearly always beef, whereas under the new ration we provided substitutes of all kinds of fresh meat, including poultry, fishes, etc. Then the butter ration was increased from a weekly allowance to a daily allowance.

The *Texas* was on the North Atlantic Station during that time. There was access to markets in Norfolk, New York, and Cuba. I was on the *Texas* until January, 1901, three years. The general mess was established on board the *Texas* by Lieut. Commander Daniel Delehanty, United States Navy, Executive Officer, and Paymaster H. E. Drury, United States Navy. The experiment began shortly before I joined the *Texas*.

Text of the 1906 Ration Law

The Navy ration as allowed by law.—(1) Sections 1580 and 1581, Revised Statutes, amended by the act of June 29, 1906, provide that the Navy ration shall consist of the following allowances of provisions to each man:

DAILY

1 pound hard bread (biscuits); or 1¼ pounds of fresh bread; or 1⅛ pounds flour.

1 pound tinned meat; or 1¼ pounds salt meat; or 1¼ pounds smoked meat; or 1¾ pounds fresh meat; or 1¾ pounds fresh fish; or 8 eggs; or 1¾ pounds poultry.

¾ pound tinned vegetables; or 1¾ pounds fresh vegetables; or 3 gills beans or peas; or ½ pound rice or other cereal.

2 ounces coffee; or 2 ounces cocoa; or ½ ounce tea.

1 ounce evaporated milk; or 1/16 quart fresh milk.

1/8 pound dried fruit; or ⅜ pound tinned fruit; or 7/10 pound fresh fruit (one ration of fruit is allowed with each ration of dried vegetables, canned vegetables, and rice and other starch foods issued).

2 ounces butter.

4 ounces sugar.

7 pounds lard for every 100 pounds flour used as bread.

WEEKLY

¼ pound cheese.	¼ pound salt.
¼ pound macaroni.	¼ pint sirup.
1/32 pound pepper.	1/128 pound spices.
¼ pound pickles.	¼ pound tomatoes (canned).
1/32 pound mustard.	½ pint vinegar or oil.

AS REQUIRED

Yeast, baking powder, and flavoring extracts are allowed in such quantities as may be necessary.

(2) In addition to the regular ration, the act of June 29, 1906, authorized an additional issue as follows: "An extra allowance of 1 ounce of coffee or cocoa, 2 ounces of sugar, 4 ounces of hard bread or its equivalent, and 4 ounces of preserved meat or its equivalent shall be allowed to enlisted men of the engineer and dynamo force who stand night watches between 8 o'clock postmeridian and 8 o'clock antemeridian, under steam."

Inasmuch as the table of equivalents under this law seemed to permit great latitude in substituting fresh food for dry and preserved foods, the authorized quantities of the different articles of food specified being generous enough to permit constantly the construction of menus that would provide a diet of high caloric value, and actual experience on board the U. S. S. *Texas* had demonstrated that the crew could be so fed in a satisfying manner under almost all conditions and circumstances likely to occur, it was believed that the new ration law would meet all needs. Nevertheless, difficulty was experienced almost from the beginning by many commissary officers because the ration was not completely flexible or elastic. This defect was corrected by the brief amendment enacted by the Congress in 1907 which provided that any article or articles of food could be issued in excess of the quantities authorized in the ration law at any time provided some other article or articles at the same time be underissued to the equivalent value in money.

This amendment was highly desirable if the men of the Navy were to enjoy a wide variety in diet and if commissary officers were to be in a position to take the greatest possible advantage of markets when fresh foods were available. Increasing knowledge of nutritional needs which has come with the passing years has further emphasized the importance of demanding a fully elastic ration, as we shall see in considering the essentials of a well-balanced diet.

As provided for in the 1906 law the Navy ration is now an allowance of food and not in any part an allowance of money for the purchase of food. Nevertheless, the question of cost can not be dismissed without further consideration. Cost of foods and foodstuffs is bound to have its place among the factors determining dietaries under all conditions; in families, whether the food be eaten at home or in hotels and restaurants, as well as in planning menus in institutions whether they be prisons, boarding schools, or ships and stations belonging to the Navy.

Although no reference to cost is made in the ration law, it remains for the Congress each year to appropriate money for feeding the

enlisted personnel of the Navy. It is therefore necessary each year for the Navy Department (Bureau of Supplies and Accounts) to satisfy the Congress that the estimated cost of feeding during the following fiscal year is justified. From the standpoint of hygiene the situation is not altogether devoid of danger. Last year the actual cost of feeding in all general messes averaged $0.52292 per capita per day. This year the Bureau of Supplies and Accounts is asking $0.50 flat, exclusive of certain losses other than those chargeable in the ration costs of the various messes. The problem of estimating cost is complicated by the fact that the appropriation also covers the money allowance for enlisted men and other persons on duty requiring subsistence elsewhere than in a general mess. It is necessary to make a close estimate of the numbers of persons who are to receive money for subsistence as well as a close estimate of the total number of rations which will be issued in kind and the probable cost of the food.

Of course, there may be a margin of savings under one or more of the other headings covered by the appropriation which can be drawn upon if the average cost of the ration for all general messes should prove greater than the estimated cost, but it is clear that having secured as much as the Office of the Budget and the Congress are willing to grant with a knowledge of past and present market conditions it will be necessary to make every reasonable endeavor to keep the cost within the estimate during the ensuing year, albeit the ration law protects the members of general messes who are entitled to their allowance of food even though prices prove higher than estimated or if unforeseen conditions occurring within the service make it impossible to provide the food within the estimated cost.

Obviously, with the present high prices of desirable foods of good quality and the many chances that food will spoil or otherwise be rendered unfit for consumption under the conditions in which it must be transported, handled, kept, and prepared for use on board naval vessels, sometimes operating for long periods away from city markets or other sources of supply, an allowance of $0.50 per man per day leaves little margin for saving if the provisions of the 1906 law are carried out as they should be in the interests of hygiene, and as they must be if the men's appetities are to be satisfied and if general contentment is to prevail among them.

Practically, it appears that about $0.50 a day can be expended at present for the purchase of food for the average enlisted man of the Navy. It is clear enough that the average daily cost of the ration will exceed this figure for certain vessels which have not access to favorable markets and on board which storage facilities, limited capacity of the refrigeration plant, and the climatic conditions encountered make for a comparatively high rate of loss through spoil-

age. The high cost of the ration in such instances must be balanced by keeping the average daily cost in other naval organizations below the average arrived at by dividing the total appropriation by 365 and again by the estimated daily strength of enlisted personnel. One year there was a separate appropriation to cover loss by spoilage, but this was small and it hardly sufficed to cover the inevitable loss that must have been expected in transporting and delivering foodstuffs to the various ships and stations under the best conditions and with the exercise of the greatest possible care. It was not sufficient to cover spoilage after delivery. It is not likely that a separate allowance for spoilage will be granted this year.

The Bureau of Supplies and Accounts must necessarily convince the appropriating body that all desirable efforts are being made in the interests of economy in connection with the purchase, transportation, and storage of foods and foodstuffs and in the handling of the ration at naval stations and on board naval vessels. That bureau has never, during the time the writer has had knowledge of its activities, taken any stand other than that the enlisted force shall be fed as well as the ration law and attainable efficiency on the part of all concerned in handling the ration will permit. It has, on the contrary, carefully guarded against the purchase of food of inferior quality or undesirable food substitutes or foods of questionable value from the hygienic viewpoint. Nevertheless, it must perforce see to it that the money expended for food during any fiscal year does not exceed the appropriation. Consequently the idea is kept before supply officers through instructions and inspections and the necessity of submitting required reports that the average daily cost of the ration must be kept as low as possible. And as hygienists we have no quarrel with the Bureau of Supplies and Accounts on that score, but as occurs with certain other questions of hygienic importance, notably that relating to economy in engineering performances and the allowance of heat, light, and fresh water on board ship, the regulations and instructions promulgated by the Navy Department, and the correct attitude of the bureau concerned, form but a part of the story which may be revealed occasionally on board ship. It is fortunate that most supply officers like most senior engineer officers in the fleet have good enough judgment to interpret instructions rationally, or one might say to read them as they are written. Neither the instructions relating to the handling of the ration nor the instructions relating to conservation of fuel contemplate parsimonious economy. It is only occasionally that a supply officer is encountered who for one reason or another has become harassed with the thought that the cost of the ration must be reduced regardless of well-founded complaints that the crew is not being fed as well as might be expected with reasonable efficiency in the commissary department. In

such instances the medical officer has a difficult task to perform. But it is a task that should not be shirked. He should, however, in discussion and in correspondence take care that all suggestions and criticisms are reasonable and constructive and based either on scientific knowledge or common sense practice. The Bureau of Supplies and Accounts can hardly be blamed if some individual supply officer displays poor judgment. We have reason to believe that some medical officers have used bad judgment at times in criticizing the management of the general mess and the Bureau of Medicine and Surgery can hardly be held responsible for that. Both bureaus endeavor properly to indoctrinate the officers who must look to them for instruction regarding technical matters.

Of course, it is an exception and not the rule to find a supply officer who appears to be striving for a very low average daily cost of the ration at the risk of promoting discontent among the crew. In general it is not good judgment to excite complaints if they can be avoided because complaints breed complaints and the resulting psychological situation is fraught with danger to the primary objective; that is, to the declared intention of keeping the cost of the ration low. That is because the conditions under which the Navy ration must be handled are such, with the authority of the commanding officer and with the required inspections by the medical officer, as prescribed by Navy Regulations, complaints about either the quantity or quality of the food if frequently repeated are very likely to lead to avoidable waste of food and increased cost even though the quality of the mess is not improved. It thus sometimes happens that a ship has the reputation of feeding poorly although the average daily cost of the ration may be considerably greater than on board another ship operating in the same fleet under similar conditions which has the reputation of feeding well. The subject might be summed up by saying that it is possible with good management to feed the crew well and at the same time to keep the cost of the ration within reasonable limits. That is enough to say at this point. Certain details bearing upon the question of management will be mentioned later. It may be mentioned in passing that zeal on the part of the fleet paymaster to stimulate supply officers to reduce the cost of the ration may have an undesirable effect from the hygienic viewpoint in certain instances where the supply officer lacks the knowledge, experience, and judgment required to differentiate between economy with good management, on the one hand, and plain bad feeding, on the other. Again, reasonable demands on the part of the fleet supply officer that foods shall be drawn by all ships from the supply ship in proportion to the way she is stocked, has been known occasionally to put before the supply officer of some particular ship a problem which seemingly he could not solve with-

out detriment to the general mess or increase in the cost of the ration.

Fundamentally, the law grants an allowance of food to the enlisted men and not an allowance of money for feeding. In emergencies the food must be purchased even though market prices be extraordinarily high. In general, however, barring unusual and isolated cases where food for certain units must be purchased locally in spite of unfavorable market conditions, and so far as the Navy as a whole is concerned, there is a cost limit imposed.

In 1906, when the present ration law was enacted, the cost of living was in general relatively low. Year by year the Bureau of Supplies and Accounts has brought about greater efficiency in purchasing supplies, storing, and transporting food stuffs and in methods of keeping, preparing, and serving food. Through these activities it has been possible, up to the present time, to feed the men of the Navy in accordance with the standards made possible by the 1906 law and the 1907 amendment in spite of the fact that increases in the allowance of money under appropriations from year to year have not equalled corresponding increases in the cost of foods in wholesale and retail markets in general. Great economy has been secured in many directions, and partly as a result of increasing experience and efficiency and partly as a result of market conditions and continued progress in the art and science of preserving meats, vegetables, and other perishable articles the dietary of the enlisted man of the Navy is or may be to-day under practically all conditions ample, well balanced, and sufficiently varied to satisfy the desires and varying preferences of all but an occasional individual. How much more can be accomplished in the way of economy and improvement in method is a question that can only be settled at some future time, but with the invincible economic law of diminishing productivity or diminishing returns in mind it seems clear that the hygienic value of the Navy ration will depend in the future largely upon the success of efforts to secure appropriations that are consistent with market prices prevailing during the year the money is being expended.

Sources of Supply of Foods and Foodstuffs for the Navy

Beside the factor cost in relation to money appropriated, certain other factors outside the cognizance of the medical department impose definite limitations upon the kinds and relative quantities of foods available to most messes under essential conditions of the naval service. These factors include keeping qualities, methods of packing, bulk, capacity of cold-storage rooms, size and suitability of other spaces or compartments available for storing foods that need not be kept refrigerated, and sources of supply for the ship or station. All of these factors obviously may have great effect upon

the mess dietary and hygienic values. For example, at a naval station located in a large city of the United States where market facilities are ample and varied, even without a refrigeration plant of its own the general mess can take full advantage of the provisions of the ration law. In such instances the ration is completely elastic. The situation is different on board a ship which has access to good markets only at infrequent intervals. In recent years, with the development of supply ships and improved methods of supplying ships of the fleet, much has been accomplished toward bringing the markets to the ships when the ships can not go to the markets. However, it is still difficult and sometimes impossible for the general mess to secure regularly during comparatively long periods important articles of food which McCollum refers to as the protective foods—fresh milk, the leafy vegetables, and some flowers and fruits. These are in fact essential constituents of a normal diet, but fortunately with good management it is possible to compensate for their absence from the diet with other resources of the Navy ration for at least several weeks at a time. For that matter it was possible in the days of sailing ships to get along without such articles for many months without definite evidence of injury to health. Nevertheless, such deficiencies are not desirable if they can be avoided, for metabolic requirements are complex and it is not possible as yet to estimate the effect of an unbalanced diet upon the duration of life even when deficiencies of essential dietary factors are suffered for comparatively short periods representing only small percentages of the average life span of man.

McCollum's recent studies indicate that although the physical damage may not be recognizable at the time or yet be traced later to dietary deficiency it is probable that even minute dietary defects which can only be determined by careful scrutiny of the diet and patient can in a comparatively short time cause physical disturbance which appears to be out of all proportion to the cause. This indirect quotation is taken from an article by McCollum, Simmonds, Kinney, and Grieves, published June, 1922, in the Johns Hopkins Hospital Bulletin and entitled, "The relation of nutrition to tooth development and tooth preservation, I." The paper deals with experimentally produced rickets, diseases of the teeth and supporting structures, and the relationship between the development of lesions and the intake of calcium, phosphorus, and vitamin D, and particularly to the effect of lack of balance between these three factors or of improper ratio between the calcium intake and phosphorus intake. One conclusion reached was that a slight variation in the American diet which always dangerously approaches the level of dietary deficiency might cause dental disease to become active at any period of lowered resistance or of physical or nervous stress.

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Complete Elasticity of the Ration

Any ration, if it is to prove satisfactory, must have full elasticity. What is meant by this? An individual in purchasing food for his family to be cooked and eaten in the home is limited in his selection of foods only by the amount of money he can afford to spend, it being understood that he has access to markets which sell foods of all kinds commonly used in the United States. Assuming that his income permits him to spend only a reasonable sum, quite within the reach of one drawing a salary that permits some of the luxuries of life in addition to necessities, the family ration or dietary can be completely elastic, and under such conditions a well-balanced diet is always possible. In many, if not most cases, the varying preferences of members of the family—that is, the collective appetite and desire for a varied diet will suffice without any knowledge of a scientific character to secure a reasonably well-balanced diet. Of course, in some instances an individual's appetite may be capricious and family habits may lead to unwise selection of foods, but, by and large, the food as consumed in most families would be found to constitute diets that avoid deficiencies even though in many instances the margin of safety regarding certain recognizable defects might not be very great. A person who takes his meals in hotels or restaurants likewise has freedom of choice. That is not the case in a boarding school, where the individual must eat the food placed before him or leave the table hungry. It is not the case in prison, where the prisoners must subsist on the food provided under the direction of the warden and selected, as a rule, under a restricted allowance of money, which often will not permit well-balanced dietaries unless the food purchased can be supplemented with vegetables grown in the grounds of the institution. So far as the prison ration is concerned, any restriction in elasticity is due to restriction in the amount of money allowed for food because markets are constantly available. In the case of the Navy ration, markets may not be available for varying periods of time, but the ration law implies that there will be no restriction as to prices, and practically the money allowance is ample. The law as amended in 1907 permits full elasticity when sources of supply are available, but the extent to which advantage is taken of this will necessarily depend upon the experience and judgment of the commissary officer.

When the ship is out of touch with markets the selection of foods for issue will necessarily depend upon the variety of foods and foodstuffs carried in the storerooms and cold-storage rooms. Most ships can not carry more than about two weeks' supplies of fruits and leafy vegetables, in warm weather at least, but it is possible to make satisfactory substitution for fresh fruits for a few days and for fresh

vegetables for a longer time with canned goods. The requirements of a well-balanced diet can be fulfilled in this way and the preferences of the men can be met so that they will remain contented, provided there is good management and advantage is promptly taken of every opportunity that presents itself to purchase fresh fruits and vegetables ashore, and milk when a safe supply can be obtained. The term, "well-balanced diet," will be discussed later.

Methods of Purchasing and Supplying Foods in the Navy

Dry provisions are all purchased centrally by the Navy Department in Washington. Such provisions are kept in store at all navy yards, from which they are obtainable by requisition. Dry provisions include canned goods, flour, sugar, macaroni, salt, vinegar, etc.

When possible a supply ship accompanies the fleet and, when circumstances permit, ships on independent duty are also periodically supplied in this way. The cargoes for supply ships other than dry provisions are purchased in San Francisco, Calif., and at Hampton Roads, Va. Bids are sent out from those places calling for delivery there. It is customary for supply ships to carry articles representing all components of the ration, and it is required that all articles carried be obtained therefrom if possible when the requisitioning vessel is not at a navy yard.

Regular monthly contracts are also in existence in United States ports and colonial possessions. These cover meats, fresh vegetables, fresh fruits, eggs, butter, fresh milk, other dairy products, and sometimes other articles. Local bulletins may be obtained by the supply officer from the supply officer of the nearest navy yard or naval station. The bulletins show current prices, names of contractors, etc.

The supply officer may also, when occasion demands, procure foods and foodstuffs by open purchase, but only when the articles required are not obtainable from a supply ship, from a navy yard or naval station, or under the terms of an existing contract at more favorable prices. An open-purchase requisition must not call for any proprietary article or item on which public competition can not be had or for any food substitute.

The following is a list of provisions usually carried in stock at navy yards and naval stations:

Apple sauce.
Apricots, tinned.
Asparagus, tinned.
Bacon, tinned.
Baking powder.
Baking soda.
Barley.
Beans:
    Kidney.
    Lima, dried.
    Navy.
    String, tinned.
Beef:
    Chipped.
    Corned, tinned.
Beets, tinned.
Biscuit.
Butter, tinned.
Catsup, tinned.
Cheese, tinned.
Citron.
Cocoa.
Coconut, shredded.
Codfish and haddock.
Coffee.
Corn meal.
Cornstarch.
Corn, tinned.
Crackers, soda.
Currants.
Extract:
    Lemon, concentrated.
    Vanilla, powder.
Flour:
    Buckwheat.
    Graham.
    Wheat.
Hominy grits.
Hops.
Jams.
Lard and vegetable shortening.
Macaroni, tinned.
Milk, evaporated.
Mincemeat.
Mustard.
Nuts, mixed.
Peaches:
    Evaporated.
    Tinned.
Pears, tinned.
Peas, tinned.
Pepper:
    Black.
    Cayenne.
Pickles.
Pineapple, tinned.
Prunes, tinned.
Pumpkin, tinned.
Raisins.
Rice.
Rolled oats.
Salad oil.
Salmon, tinned.
Salt.
Sardines, American, tinned.
Sauce, Worcestershire.
Sauerkraut, tinned.
Sausage, Vienna, tinned.
Spices:
    Allspice.
    Cinnamon.
    Cloves.
    Curry.
    Ginger.
    Sage.
    Thyme.
Spinach, tinned.
Sugar:
    Granulated.
    Powdered.
    Brown.
Sirup.
Tapioca.
Tea.
Tomatoes, tinned.
Vinegar.

The following provisions are usually obtainable under existing contracts:

Bread:
- Wheat, loaves.
- Graham, loaves.
- Rolls.

Butter, extra creamery.
Cheese, full cream.
Clams.
Eggs.
Fish.
Fruits:
- Apples.
- Bananas.
- Berries, all kinds.
- Cantaloupes.
- Cherries.
- Cranberries.
- Grapefruit.
- Grapes.
- Lemons.
- Oranges.
- Peaches.
- Pears.
- Pineapples.
- Plums.
- Watermelons.

Ice.
Milk.
Meats:
- Bacon, sugar-cured.
- Beef—
  - In quarters, fresh, or frozen.
  - Chucks.
  - Corned.
  - Loins, full.
  - Loin ends of hips.
  - Ribs, full.
  - Rounds.
  - Rumps.
- Hamburger steak.
- Hams, sugar-cured.
- Headcheese.
- Liver, beef.
- Luncheon meat.
- Mutton—
  - Carcasses, fresh or frozen.
  - Leg.

Meats—Continued.
- Mutton—Continued.
  - Rack.
- Pork loins, fresh or frozen.
- Sausage—
  - Bologna.
  - Frankfurter.
  - Pork.
- Shoulders, sugar-cured.
- Tongues, beef.

Poultry:
- Chicken, fresh or frozen.
- Fowl, fresh or frozen.
- Turkey, fresh or frozen.

Olive oil, hospitals only.
Oysters.
Vegetables:
- Asparagus.
- Beans—
  - String.
  - Lima.
- Beats.
- Cabbage.
- Carrots.
- Cauliflower.
- Celery.
- Corn on cob.
- Cucumbers.
- Eggplant.
- Lettuce.
- Onions.
- Parsley.
- Parsnips.
- Peas, green, in pod.
- Peppers, green and red.
- Potatoes—
  - Irish.
  - Sweet.
- Pumpkins.
- Radishes.
- Rhubarb.
- Spinach
- Squash.
- Tomatoes.
- Turnips.
- Yeast.

Table of components.—The Bureau of Supplies and Accounts includes in its instructions to supply officers the following table based on the ration law with the statement that all articles of provisions received by transfer from supply officers at navy yards and stations, and from supply officers afloat, as well as articles received from dealers ashore, either under contract or by open purchase, with the exception of certain miscellaneous articles mentioned below, will be issued in accordance with the table:

Components	Ration allowance
Bread:	
Biscuit	
Crackers—	1 pound.
Soda	
Oyster	
Bread—	
Fresh	
Wheat	1¼ pounds.
Graham	
Rolls	
Flour—	
Wheat	
Graham	1⅛ pounds.
Buckwheat	
Corn meal	
Meat:	
Preserved (tinned)—	
Bacon	
Corned beef	
Chipped beef	
Codfish and haddock	1 pound.
Salmon	
Sardines	
Sausage (Vienna)	
Luncheon meat	
Salt—	
Corned beef, fresh	
Salt pork	
Salt mackerel	
Smoked—	
Bacon, sugar-cured	1¼ pounds.
Ham, sugar-cured	
Shoulder, sugar-cured	
Sausage, Frankfurters	
Sausage, bologna	
Tongue, beef	
Fresh—	
Beef	
Mutton	
Pork	
Veal	
Sausage, pork	
Liver, beef	1¾ pounds.
Hamburger steak	
Chicken	
Fowl	
Turkey	
Fish, fresh	
Eggs	8 in number.
Vegetables:	
Dried—	
Beans—	$\frac{3}{32}$ gallon.
Navy	
Lima	
Kidney	
Canned—	
Beans—	
Lima	
String	
Corn	¾ pound.
Peas	
Tomatoes	
Pumpkin	
Beets	
Fresh—	
Turnips	
Carrots	
Tomatoes	1¾ pounds.
Beets	
Vegetables—Continued.	
Fresh—Continued.	
Onions, green	
Squash	
Pumpkin	
String beans	
Peas, green, in pod	
Corn, green, sugar, on cob in husk	
Spinach	
Cauliflower	
Lettuce	
Cucumber	
Celery	
Radishes	1¾ pounds.
Rhubarb	
Parsnips	
Eggplant	
Peppers, green, red	
Asparagus	
Parsley	
Potatoes—	
Irish	
Sweet	
Onions	
Cabbage	
Cereals and starch foods:	
Rice	
Cornstarch	
Barley	
Hominy	½ pound.
Oats, rolled	
Tapioca	
Fruits:	
Dried—	
Apples	
Citron	
Currants	$\frac{3}{16}$ pound.
Coconut, shredded	
Peaches	
Raisins	
Canned—	
Apples	
Apricots	
Peaches	
Pears	
Pineapple	⅜ pound.
Prunes	
Preserved—	
Jams	
Apple butter	
Mincemeat	
Fresh—	
Peaches	
Pears	
Cherries	
Grapes	
Berries, all kinds	
Cranberries	
Watermelon	$\frac{9}{16}$ pound.
Cantaloupe	
Plums	
Grapefruit	
Pineapple	
Apples	
Bananas	
Lemons	
Oranges	

Components	Ration allowance	Components	Ration allowance
Beverages:		Pickles [1]	1/4 pound.
Coffee	1/8 pound.	Salt [1]	1/4 pound.
Cocoa	1/8 pound.	Sirup [1]	1/4 pint.
Tea	1/32 pound.	Spices [1]	1/128 pound.
Milk:		Sugar	1/4 pound.
Evaporated	1/16 pound.	Tomatoes (tinned)	1/4 pound.
Fresh	1/16 quart.	Vinegar and sauces: [1]	
Butter	1/8 pound.	Vinegar	1/2 pint.
Cheese [1]	1/4 pound.	Oil, salad	1/2 pint.
Lard	7 pounds to every 100 pounds flour as bread.	Sauce, Worcestershire	1/2 pint.
		Catsup	1/2 pint.
Oil, cottonseed	As lard substitute in proportion of 1 gallon to 10 pounds lard.	Extracts, flavoring:	
		Vanilla	As required.
		Lemon	As required.
		Baking powder	As required.
Macaroni [1]	1/4 pound.	Baking soda	As required.
Mustard [1]	1/32 pound.	Yeast	As required.
Pepper [1]	1/32 pound.	Hops	As required.

[1] Indicates weekly ration, all others daily.

Articles not mentioned in the table of components which can properly be classified under any of the ration components may be taken up and issued as ration equivalents.

Provisions which can not be classified under any of the ration components, such as oysters, clams, ice cream, cake, pies, candy, nuts, etc., may be issued as "miscellaneous" by value which must be offset by corresponding value of "under-issues."

Equivalents for the additional ration authorized for men standing night watches (engineer force and dynamo force).—Each enlisted man of the engineer force or dynamo force who stands a night watch between 8 p. m. and 8 a. m. under steam shall be allowed an extra ration as follows:

One ounce coffee or cocoa.

Two ounces sugar.

Four ounces hard bread, or 5 ounces soft bread, or 4½ ounces of flour as bread.

Four ounces preserved meat, or 5 ounces salt or smoked meat, or 7 ounces of fresh meat, or 2 eggs.

Table indicating 30-day provision supply for 1,000 men.—The following table is given in the Manual for Supply Officers, United States Navy, as the basis on which provisions may be procured:

Article	Unit	Provisions for 1,000 men for 30 days	Number of packages	Total gross weight (pounds)	Total cubic feet
Apple sauce	Pound	936	24	1,248	37.92
Apricots, tinned	do	675	15	945	22.50
Asparagus, tinned	do	372	8	512	10.64
Bacon, tinned	do	432	6	594	16.20
Baking powder	do	120	4	168	4.80
Baking soda	do	36	1	43	1.00
Barley	do	100	1	101	2.20
Beans:					
Kidney	do	300	3	303	7.00
Lima, dried	do	600	6	606	12.48
Navy	do	2,400	24	2,424	61.92
String, tinned	do	741	26	1,092	26.00

Article	Unit	Provisions for 1,000 men for 30 days	Number of packages	Total gross weight (pounds)	Total cubic feet
Beef:					
Chipped	Pound	72	1	101	2.11
Corned, tinned	do	720	10	920	20.00
Beets, tinned	do	246	6	312	8.00
Biscuit	do	150	3	231	10.50
Butter	do	2,880	36	3,959	75.60
Catsup, tinned	Gallon	108	24	1,296	37.92
Cheese, tinned	Pound	240	4	316	7.64
Citron	do	10	1	13	.40
Cocoa	do	120	3	180	6.30
Coconut, shredded	do	40	2	50	2.66
Codfish and haddock	do	144	3	201	4.50
Coffee	do	2,400	24	2,880	144.00
Corn meal	do	200	2	210	4.60
Cornstarch	do	1,200	40	1,680	40.00
Crackers, soda	do	66	3	96	6.60
Extract:					
Lemon, concentrated	Bottle	6	1	9	2.50
Vanilla, powder	Pound	24	1	37	1.50
Flour:					
Buckwheat	do	100	1	101	2.33
Graham	do	200	2	202	2.22
Wheat	do	24,000	240	24,240	559.20
Ham, smoked	do	380	4	620	15.32
Hominy grits	do	300	3	303	10.00
Hops	do	25	1	32	1.50
Jams, assorted	do	960	20	1,320	23.20
Macaroni	do	400	8	536	16.80
Milk, evaporated	do	3,120	65	4,225	110.50
Mincemeat	do	150	3	168	4.50
Mustard	do	24	1	40	1.16
Nuts, mixed	do	50	1	62	2.25
Peaches, evaporated	do	100	2	130	3.16
Peaches, tinned	do	1,001	22	1,386	33.00
Pears, tinned	do	720	16	1,003	24.00
Peas, tinned	do	1,260	42	1,764	42.00
Pepper, black	do	48	2	80	3.00
Pickles	do	276	3	489	9.30
Pineapple, tinned	do	450	10	630	17.00
Prunes, tinned	do	504	12	696	13.92
Pumpkin, tinned	do	320	8	408	10.00
Raisins	do	200	5	265	6.65
Rice	do	1,200	12	1,212	33.96
Rolled oats	do	432	8	560	18.64
Salad oil	Gallon	56	7	560	12.60
Salmon, tinned	Pound	528	11	770	16.50
Salt	do	1,200	12	1,212	18.00
Sardines, American, tinned	do	150	6	264	6.60
Sauce, Worcestershire	Gallon	5	1	60	1.50
Sauerkraut, tinned	Pound	577	15	750	20.00
Sausage, Vienna, tinned	do	288	6	450	6.60
Spices, assorted	do	24	1	40	1.08
Spinach, tinned	do	288	8	400	9.20
Sugar:					
Granulated	do	8,600	86	8,696	202.71
Powdered	do	100	1	101	2.50
Sirup	Gallon	80	15	1,110	19.95
Tapioca	Pound	100	1	101	1.11
Tea	do	190	2	240	10.50
Tomatoes, tinned	do	2,832	57	3,876	94.62
Vegetable shortening	do	1,280	32	1,728	41.60
Vinegar	Gallon	64	4	648	17.32
Meats, refrigerated	Pound	27,000		29,160	1,215.00
Eggs	Dozen	600	20	1,200	46.60
Ham and bacon, sugar-cured	Pound	1,209	13	2,080	49.92
Vegetables, fresh	do	47,000	470	56,400	1,880.00
Fruits, fresh	do	6,000	80	6,800	168.00
Yeast	do	75	3	90	1.50
Total				177,985	5,391.16

Percentages of fresh meats and vegetables allowed by instructions of the Bureau of Supplies and Accounts.—(1) Of the total quantities ordered under contract or procured by open purchase during any one month, or in any port when fitting out for sea, at least 70

per cent of all fresh vegetables shall be Irish potatoes, and the following proportions of fresh meats will be strictly adhered to:

Not more than 15 per cent pork.
Not less than 60 per cent beef.
Not more than 10 per cent sausages.
Not more than 5 per cent veal.
Not more than 5 per cent fowl.

(2) The percentage of beef will include liver. Supply ships will be loaded in the exact percentages stated above, except that when the cargo is intended for vessels in the Tropics the percentage of beef will be increased to 65 and of pork decreased to 10. The provisions of this paragraph do not apply to vessels whose crews are subsisted in accordance with article 1411, Navy Regulations.

Approximate gross fuel value and nutritive ratio of the articles listed in the above table as representing a 30-day provision supply for 1,000 men.—The values per man per day are as follows:

Calories furnished by proteins	470
Calories furnished by fats	1,528
Calories furnished by carbohydrates	1,536
Total calories	3,534

Of the total calories, protein calories equal 13 per cent. The nutritive ratio is, therefore, 1 to 6.5. By weight the values are proteins, 117 grams; fats, 170 grams; carbohydrates, 384 grams per man per day.

The figures make no allowance for waste which is usually considered to be from 20 to 25 per cent, including both avoidable and unavoidable waste ordinarily involved in handling the ration. These figures obviously do not represent full values as authorized by the provisions of the ration law. The minimum, maximum, and usual fuel value of the Navy ration as issued will be discussed later. The table is based on experience and is useful as a guide to supply officers in stocking up for a cruise but it is not to be taken that the crew is to be limited to the articles and quantities listed therein.

THE GENERAL MESS

Duties of the Medical Officer in Relation to Food Served in the General Mess

The Navy Regulations provide that the medical officer shall inspect as to their quality all fresh provisions delivered to the ship, and that he shall, when required, inspect the provisions of the crew and report any that are unsound or likely to cause illness. The regulations also require that he report to the commanding officer any want of care or cleanliness or any neglect in the preparation of food for the crew which may be injurious to health. The regulations further

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provide, "The commanding officer shall see that all cooking and mess utensils are kept clean; that the food is wholesome and well cooked. Only pure water, distilled when practicable, shall be allowed for drinking or culinary purposes, and no water shall be issued for drinking until it has been examined and approved by the medical officer."

"If any of the crew object to the quality of the provisions issued to them, the supply officer shall at once request a survey.

"If in the judgment of the surveying officer, the provisions are of proper quality, they shall be issued, notwithstanding objections, unless the commanding officer shall direct otherwise. If, however, the provisions are not approved, others of a better quality shall, if on board, be at once issued in their stead."

The regulations which relate to the medical officer's duties and responsibilities are very broad. They obviously contemplate a check upon the *quality* of all foods and foodstuffs, and upon the *character* and *condition* of the food as served in the general mess, by the medical department, a department other than that which supplies and prepares the food. That adequate *quantities* of food will be served is provided for by the ration law and the authority of the commanding officer exercised through regular inspections by the officer of the deck and through the investigations of any other officer who may be designated by him to hear complaints.

Fortunately, there are many reasons why all concerned should want to see the crew well fed. All recognize or should recognize the importance of promoting contentment and removing any cause for reasonable complaint whether it be directed against quantity or quality of the food.

It is clear that hygienic factors can not be separated altogether from economic and psychologic factors.

The duties of the medical officer may perhaps be considered under two divisions:

1. Protection of health—inspections of foods and foodstuffs and recommendations calculated to prevent infection or poisoning by food.

2. Suggestions and recommendations made with the object of securing a well-balanced dietary for the crew.

The supply officer should undertake in administering his department to satisfy the crew. Ideas expressed by the medical officer that conflict with this idea, whether they be founded on science or based on fad or whim, are not likely to have any practical value. The supply officer must be governed by the instructions of the Bureau of Supplies and Accounts which are designed in the interests of the Navy as a whole and based on experience. As pointed out above there are certain limitations imposed not only with respect to cost

but also with regard to balance of the ration as purchased and as procurable from supply ships and other sources within the service.

Summarized, it is the duty of the supply officer to procure adequate quantities of acceptable foods in proper proportionate amounts to permit constantly or regularly the construction of menus consistent with a well-balanced dietary and at the same time conform to reasonable cost requirements; to see to it that the crew is well fed; to prevent waste of food in preparation, cooking, and serving *in so far as efforts to curtail waste do not conflict with good hygiene or induce reasonable complaints among the crew;* to prevent loss through spoilage by judicious selection or purchase with due regard for the keeping qualities of the various foods procured, having in mind facilities for storage within the organization and the probable period of separation from sources of supply, and by the timely use of perishable foods and articles which have relatively poor keeping qualities.

In purchasing food supplies the supply officer must be governed by cost, storage facilities, bulk of foods, methods of packing, keeping qualities, acceptability to the crew, and present and probable future sources of supply.

Acceptability

Practically, the desires of the crew must have or should have great weight in determining the kind and variety of food served in the general mess. The task is one of catering to the collective appetite. There may always be a few individuals who are not satisfied by meals that are highly acceptable to the majority. Complaints by a few scattered individuals are of no significance when other men are ready to assert positively that the meals are satisfactory. Occasional complaints have more significance when assurance is lacking that the majority are contented. Frequent complaints by many men in different parts of the ship almost always mean that conditions are not satisfactory. The morale and even the discipline of the ship is in danger when complaints are numerous and frequently repeated. *A wise supply officer will see to it that every practicable effort is made to meet the varying preferences of the crew.* A number of factors are associated with varying preferences—physiological needs, variety and character of the food, the manner in which it is cooked and served, climatic conditions, work conditions, and movements of the ship. A monotonous diet of limited variety naturally will fail to promote contentment after a comparatively short time. But the question of balance must be considered in this connection. A simplified diet restricted to a very few articles of food may be a satisfying diet for a long period if the few articles constitute a

well-balanced diet. A diet of very limited variety to prove satisfactory for any considerable length of time must almost of necessity include fresh milk, which is in itself a balanced diet.

A diet consisting of a comparatively small list of foods will continue to satisfy the appetite and all physiological needs in general according to the proportionate amounts of the protective foods that are included—milk, eggs, and the leafy vegetables, together with fruits. There are certain other articles which are usually tolerated indefinitely without rebellion on the part of the tissues, a form of rebellion that finds expression in a lessened appetite or actual distaste for the food in question. For example, bread, crackers, etc., made from wheat flour, white or whole wheat, may be eaten every day by most people without distaste provided other foods supply all essential dietary factors. Beef may be eaten quite constantly without exciting resentment by the organs and tissues. On the other hand, some delectable foods such as turkey meat, goose, etc., would soon excite aversion if eaten every day. One loses temporarily his desire for a given article of food either because (*a*) it contains some chemical compound for which the body has a limited tolerance, or (*b*) the food in question is lacking in some essential amino acid or some other essential factor. This summarized statement is of little value from a practical standpoint because it can not be applied to most of the foods commonly eaten. Knowledge of the exact chemical composition of most foods, that is the exact make-up of the amino acid compounds which constitute the proteins of the food, and possibly knowledge of other constituents, is not complete enough yet to throw much light on the question of limited tolerance and the less common condition where a food that is wholesome for most people disagrees always with certain individuals. There is also the condition of frank idiosyncrasy to be considered, a form of reaction commonly regarded as one of the phenomena of anaphylaxis resulting from sensitization to a specific protein.

A few well-selected foods will serve as a well-balanced diet indefinitely, but lack of variety when due to limited availability of foods, absence from sources of supply, etc., or to poverty, or to bad habits, family or personal, handed down or acquired, or to vagaries of appetite in the case of an individual is much more likely to involve deficiency of one sort or another than when the diet comprises a wide variety of foods. On the other hand, one should not lose sight of the fact that the diet may include a great variety of foods and yet be lacking or deficient in one essential factor or another, and that calcium and other minerals are of great importance as well as the essential amino acids and vitamins.

The Navy ration as ordinarily handled can not be wholly lacking in any essential factor known or as yet unknown, but with the small

amount of milk included on board ship it is possible for the diet to be relatively deficient in certain respects as, for example, in calcium.

Other foods which are the principal sources of calcium in utilizable form, such as eggs, peas, beans, string beans, carrots, parsnips, turnips, cabbage, spinach, apples, oranges, pineapples, etc., may not be served often enough or eaten in sufficient quantities to take the place of milk in full. Similar remarks apply to certain other features of an incompletely balanced diet. In general, with the exception of iodine, so long as the diet regularly includes a generous amount of milk there is little chance for any form of deficiency; that is, assuming other foods that will satisfy the varying preferences of the men are available as they should be with the elastic Navy ration. But when milk is lacking some intelligent thought is required in handling the ration to see to it that its place in the dietary is satisfactorily filled by other foods of which several must ordinarily be required. Often when fresh milk is not procurable fresh vegetables are not either, and inasmuch as these are the most natural substitutes for milk in its rôle of the leading protective food, considerable ingenuity is required to fulfill all the requirements of a balanced diet with canned goods and other preserved foods, even though little concern need be felt about deficiencies of any of the known vitamins under such conditions. An exceptional case might be that of a man who stays below decks so much of the time that deficiency of ultraviolet light is induced.

One of the principal difficulties is that substitutes for fresh vegetables may not be eaten by some or many of the men in adequate amounts even if served regularly. Preference for meat, bread, potatoes, and sweet deserts is likely to outweigh desire for canned vegetables, evaporated milk, etc., unless menus are skillfully constructed so that canned goods are used in such a way and the food is so well cooked that the men will not for the most part eat the meat and leave the vegetables. Of course, a high salaried chef knows how to prepare many dishes with canned vegetables that would be relished by almost anyone. On the other hand, canned vegetables are sometimes used in general messes and served in such manner that it is not surprising if they are rejected by many of the men and increased quantities of meat eaten instead.

The commissary officer must cater to the group or collective appetite in contradistinction to the appetities of individuals. Although he may not have very much knowledge of the science of nutrition a reasonably well-balanced diet will ordinarily be offered if the varying preferences of the crew as a whole are followed and contentment with respect to food prevails. The group appetite of the men in the Navy, drawn as they are from homes in all parts of the United States where food is abundant in quantity and variety, can be

trusted to a great extent to select foods that will provide all essential factors. To begin with, the ration components and the instructions regarding the relative quantities of the different foods to be purchased or drawn from sources of supply are based on past experience in satisfying the desires of Navy crews. An individual's appetite may of course lead to unwise selection of food especially if he purchases his own food and more especially if he eats in hotels or restaurants. It is also true that racial habits and customs sometimes lead to beri-beri, pellagra, or other deficiency disease when the food eaten constitutes a diet that is most acceptable to great numbers of compatriots and neighbors. On the other hand, man has selected his food from the animal and vegetable kingdoms down through the ages unguided until very recently by any knowledge of the chemistry of nutrition. In the struggle for existence against opposing forces in the environment, it may be taken for granted that the fittest survived and that habits of eating in their descendants have been based upon the ability of the tissues to adapt their needs to the foods available. It may be assumed that the average individual has been endowed through evolutionary adaptations with the power of satisfying his biological needs with no strictly limited variety of food.

It may be assumed that a considerable excess of nutriments above optimum requirements can be taken care of when food is abundant, and it is of course obvious that a healthy man can perform hard work without food for a considerable period of time when food is not obtainable, depending upon the amount of stored nitrogen and fat in his tissues. Man could not have evolved in conflict with a changing environment without developing latitude of tolerance with respect to quantity of food. We may account for the fact that man and other animals are entirely dependent upon their food for certain active principles, which have accidentally become known as vitamins, by assuming that inasmuch as all of these, known and unknown, were to be found in a great variety of foods in their natural state at all periods in the course of evolution, ability to synthesize these substances would not develop.

A study of the diets ordinarily taken by families in different circumstances, selected at random with statistical fairness, among peoples having access to abundant supplies of the common foodstuffs can be expected to reveal in general the foods that are best for the human race, and the foods generally consumed in families fairly representative of the well-to-do classes can be expected to include all essential dietary factors and to represent about the optimum quantities of proteins, fats, and carbohydrates to satisfy tissue and energy requirements. Such studies were made by Voit in Germany and by Atwater in the United States. There are those who believe

their findings regarding optimum quantities of food should be disregarded, but that point will be discussed later.

Here it need only be said that men and women lived, many of them to ripe old age, and reproduced their kind successfully on food that agreed, or at least did not seem to disagree with them, from prehistoric times without knowledge of the chemistry of foods and without great concern about quantity so long as they had enough to satisfy their appetites. It may or may not be that the science of nutrition has now developed to a stage where the average span of life could be increased by substituting for the dictates of the group appetite complete scientific control over the character and quantity of food to be ingested. Probably not, for so far as the writer knows, up to the present time no one has succeeded in constructing for rats and other animals a simplified experimental diet that has proved wholly adequate to meet all biological needs. Take the rat, for example; he manages to live and reproduce the species at an amazing rate in spite of constant warfare waged against him by man, so long as he is privileged to forage for his food at large and follow the dictates of the rat appetite. When fed on a diet that is completely balanced, so far as can be determined with scientific knowledge now available, he likewise grows up normally, reproduces his kind, and lives out his expected life span, but after several generations the descendants are not such vigorous and sleek furred animals as the corresponding generations of rats that have eaten according to their instincts.

It is well to keep these points in mind to avoid being influenced by faddists who always spring up to advocate some new doctrine concerning diet with each new discovery. It is true, of course, that each new discovery is valuable and that great numbers of lives have been saved by the knowledge already obtained of essential dietary factors. It is also true and it is especially important that those who are responsible for planning the diets of other persons and thus are responsible for deficiencies if they occur shall have full knowledge. Prisoners are very dependent upon the official who provides their food, for they can follow their instincts in the selection of food only in a very restricted manner. Naval personnel are safeguarded by the elasticity of the ration law and by the right to complain, and as we have seen, the articles comprising the ration as ordinarily served conform to past dictates of the collective or group appetite.

Now, in practice, the desires of the crew must ultimately prevail, even though they conflict with scientific findings, because if the men were not satisfied with the food they would not reenlist, and general dissatisfaction would bring about an impossible situation. So when all is said and done every practical consideration demands that the dictates of the group appetite govern whether or not we

are inclined to regard it as a safe guide. Fortunately, it probably is, in general, a safe guide to proper feeding, but it is still important to apply scientific knowledge, for the reason that to-day with the milled, processed, and preserved foods largely taking the place of foods in the original condition as Nature provided them, the palate may be pleased and the appetite satisfied by a diet that is far from being well balanced. The point is that if natural foods of the order described as protective foods were regularly offered to the crew there can be little doubt that most of the men would turn to them by natural preference. If such foods are not available other foods will of course be eaten and these may satisfy the men even though they do not promote equilibrium of certain essential elements. Within certain limits the preferences of the crew may be guided toward desirable foods by providing them. In other words, although the preferences of the men must be followed it is also possible to lead them by experience and knowledge in a manner that is highly desirable from the standpoint of hygiene, for many individuals in the group will thus eat food that is more suitable for them than would be the case without skillful management. Under all circumstances the men go to the mess table and decide for themselves what of the articles provided they will take and how much and how little of each they will eat. Often, doubtless, the diet consists largely, day in and day out, of meat, white bread, and potatoes, with sugar in desserts and very little evaporated milk in coffee. Not infrequently individuals who have formed such a diet habit would be induced to eat more of the protective foods and correspondingly less meat, cereal, and sugar, divorced from vitamins and minerals, if more care and intelligence were directed toward the construction of menus. Good management to this end decreases rather than increases the average daily cost of the ration, partly because less food is wasted and partly because, with a well-balanced diet, less food is required for the average individual.

The commissary officer and his assistants are guided in estimating the preferences of the crew (*a*) by the quantities of the various foods left uneaten at the mess tables; (*b*) by the frequency and nature of complaints; (*c*) by questioning members of the crew; (*d*) by data furnished by the Bureau of Supplies and Accounts and other recorded experience in feeding Navy crews; and (*e*) by suggestions made by the medical officer based in turn upon information that has come to him from members of the crew.

Waste and Relationship Between Waste and Acceptability of Foods

Food as purchased consists of the *edible portion* and *refuse.* Refuse comprises bones, entrails, shells, bran, skins, and seeds of fruits and vegetables, etc. *Refuse is not included in estimations of*

food wasted, although it is true that some kinds of refuse, for example, bones and certain seeds and pits contain utilizable mineral matter as well as proteins and fats or carbohydrates. In some cases material that would otherwise be edible must be classed as refuse because of a naturally objectionable flavor. By waste is meant only edible portion, not refuse.

Of the edible portion, all purchased that is not eaten is to be regarded as food wasted. The edible portion of food consists of water, mineral matters, nutrients, certain active principles (rather badly named, vitamins), and fiber or cellulose in certain fruits and vegetables. Nutrients are proteins, fats, and carbohydrates. In practice it is necessary to distinguish between *avoidable waste* and *unavoidable waste.*

Unavoidable waste.—There are several forms of unavoidable waste. It is clear that in preparing many articles of food for the table a certain amount of edible portion must unavoidably be sacrificed, depending upon the character of the article, the time available for preparation, facilities for preparing and cooking, adequacy and competence of culinary personnel, practicability of recooking or otherwise using food left after a meal, and occasionally some other factor. With all forms, no sharp line can be drawn between unavoidable and avoidable waste, but manifestly some waste is unavoidable even if the greatest care be exercised. For example, if potatoes are to be peeled by hand, it is practically impossible to avoid sacrificing some of the edible portion, yet if the "spuds" are peeled by the deck force, extra duty men, etc., there may be so much wasted that some of the waste is clearly avoidable. Some of the waste might be attributed to lack of skill, and so might be considered avoidable, but circumstances may make it necessary to assign unskilled men to the work, and other factors may make a certain amount of waste preferable to delay and interference with other activities.

Cooking necessarily involves the loss of some nutrient material. It may sometimes appear that less waste would occur if the articles were cooked in a different manner, but other considerations may demand that the cooking be done as it is. However, if as a result of bad cooking the food is rejected wholly or in part by the men, there is avoidable waste. Obviously here again no sharp distinction can be made, for acceptability depends upon many factors besides good and bad cooking, and good and bad cooking may be and often are relative terms.

Waste may occur as a result of spoilage before the food is issued for cooking and serving. Spoilage may have occurred because perishable articles were not used in time, and failure to use may have been due to bad management, but on the other hand there are often good reasons in the interests of providing fresh foods over

as long a period as possible during a cruise to justify taking a chance on spoilage. Under some circumstances the waste that results in this way from spoilage can fairly be regarded as unavoidable. Again, spoilage may occur because through accident to the refrigeration plant the temperature rises in cold storage spaces. Certain foods may be damaged in other storerooms by flooding, etc. Clearly, if it was not within the power of the supply officer to foresee and prevent such loss it must be regarded as unavoidable waste so far as the commissary department is concerned.

It is clear, too, that the availability of sources of supply has much to do with waste, not only in connection with the prevention of spoilage but also because with a variety of highly acceptable foods constantly available it is possible to construct menus that will insure a minimum of waste at the mess tables.

Table waste.—It is a natural tendency when any given food served is left in considerable quantities at the mess tables to issue less of it for subsequent meals. That is a proper procedure if care is taken not to excite complaints. It is one of the methods of gauging acceptability. However, certain important considerations should be kept in mind. Each article of food must be issued in the amount indicated by broad experience as sufficient for the number to be fed. Food left at the table should be considered as having been left by certain individuals. The man who eats all his bread, or potatoes or what not must not be made to suffer because another man eats only part of his or because certain men load their plates with more food than they are likely to eat. Reduction in the quantity issued should not be permitted merely because there appears to be a waste of food unless the system of distributing the food is such that waste by certain individuals can be curtailed without placing other men who eat all their food at the mercy of the commissary department. Of course, any great underissue or regular tendency to underissue would provoke so many complaints that eventually remedial action would be secured, but there are borderline cases that should not be tolerated.

Method of distributing food as affecting waste.—When it is practicable to establish a cafeteria system of distributing the food, it is possible and proper to reduce the portions of the various articles served to such a degree that comparatively little food will be wasted at the mess tables, because the man who needs or desires more of a particular article can go back to the serving table for another portion. To a less extent it is possible to adjust the supply to varying appetites when the food is delivered at the mess table in food containers and portioned out there under competent supervision. If the men are allowed to help themselves in the first place there will almost inevitably be considerable waste.

With any system there must be a certain amount of food wasted in a Navy general mess. Much of it must be regarded as unavoidable waste, for to be preventable it would be necessary to have the power and facilities for determining exactly how much each individual should eat, serve him exactly that amount, and see to it that he leaves no food on his plate. Often, of course, waste at the mess tables is in excess of the unavoidable amount, and, theoretically at least, it is possible to reduce the loss by better management or by substituting a better system of serving.

From the economic viewpoint the cafeteria system of messing is highly desirable and it is entirely consistent with good hygiene. It is also entirely practicable at certain naval stations and for the feeding of convalescent patients in naval hospitals. As with any other system, good management and a thorough understanding of the features peculiar to it are required if it is to work satisfactorily in practice. Adequate space, suitable equipment, and proper arrangement of steam tables and other serving tables are essential. The cafeteria system has been tried out in a few general messes on board ship. A few supply officers have considered it practicable, but in general it is not well adapted to ship conditions because it conflicts with other activities. To be entirely satisfactory, arrangements would have to be made so that the crew could be served from several points. As a rule it is an essential condition that the time for eating is limited, and the crew must, with certain exceptions, eat at the same time, and mess gear must be washed and stowed at the same time.

If the cafeteria system is regarded as impracticable on board ship then a considerable amount of food that could be saved in this way must be lost and the loss must be charged to unavoidable waste because it is due to essential service conditions, although doubtless in certain instances some of the waste is avoidable.

Responsibility for waste.—The supply officer, not the medical officer, is responsible for avoidable waste. Medical officers have been known to make remarks like the following: "Say, the amount of food wasted on board this ship is a crime." Such a remark is almost sure to be resented. It is a criticism that is both destructive and offensive. It is rather the medical officer's duty to be on guard and to see to it, when sudden efforts are being made to curtail waste in a belated endeavor to reduce the average daily cost of the ration, that unjustifiable attempts are not made to reduce waste that is unavoidable with the system of messing in vogue. The medical officer should ordinarily make suitable recommendations when it appears that there are grounds for complaint that too little food is being served and when it appears that the most acceptable foods and especially leafy vegetables and fruits are not being served often enough. Of course,

there is no reason why the medical officer should not in a nice way give the supply officer any information based on his observations that he thinks the latter might like to have.

And furthermore he should, from the hygienic viewpoint, consider the significance of excessive waste at the mess tables, for excessive waste probably means that some of the foods served are not acceptable to the desired extent. That may be due to overissue or it may be due to the fact that the foods which are principally wasted are not generally liked by the crew, either because of their nature or because they were badly cooked or served in such a way as to be relatively unacceptable. Whatever the cause, excessive waste is not compatible with the desired result that an abundance of good food at a reasonable cost be provided in sufficient variety so that as many individuals as possible will actually be eating food consistent with well-balanced diets. The menu sheets may indicate that the meals are fairly well balanced, but, if considerable proportions of the foods served are not for the most part acceptable to the men, they will not be following well-balanced diets. Very often the food eaten will consist chiefly of meat, bread, potatoes, black or nearly black coffee, and such desserts as are served.

It is important to note what foods especially are going to waste if rational corrective measures are to be applied.

Estimated total waste.—Average waste, avoidable and unavoidable combined, under ordinary conditions probably amounts to between 20 and 25 per cent of the edible portions of foods purchased. This would not include loss of large quantities of meats or other foods through accidents to ice machines or damage by flooding or otherwise to dry provisions in storerooms. It would not include spoilage occurring while goods are being shipped but not discovered until accepted and stored. Gatewood reached the conclusion that total waste of nutrients did not average less than 25 per cent. In naval hospitals to-day, with the cafeteria system of feeding and sources of supply constantly available, total waste is probably not much less than 20 per cent, and probably there is almost as great a percentage of waste in many homes. On board ship the percentage must almost inevitably run higher; under some circumstances higher than 25 per cent.

Relationships between table waste and acceptability.—The serving of any article at any meal that is relatively or absolutely nonacceptable at the time to a considerable number of the men will necessarily cause avoidable waste. An article may be constantly or nearly always rejected by a considerable proportion of the crew, veal, for example, or it may usually be quite acceptable if not served too often; chicken, ham, baked beans, frankfurters, chipped beef, etc. Some foods are acceptable regularly or at frequent intervals in small

amounts but the serving of larger portions will result in avoidable waste. Badly cooked food ordinarily is either absolutely or relatively nonacceptable. Whatever the cause, food served but not accepted, finds its way into the garbage can or chute and is food wasted, and food wasted materially increases the cost of the ration, for the average man being healthy and young and performing an average amount of work, demands a certain quantity of food to put into his stomach each day to satisfy his healthy appetite, and this amounts in weight to between 4 and 5 pounds of food as served, or more than 5 pounds as issued. If he rejects one article or another he will satisfy his appetite with the other foods served, or if he can not do that he will complain to the officer of the deck. The end result when such substitutions are made generally among the crew is that more of the acceptable article must be provided or other acceptable food must be furnished. This, as well as the food rejected, has a money value and the total cost is represented in the cost of the ration.

It pays to serve food as well cooked as it can be cooked with available facilities. Take beefsteak for example. That is, in general, among the highly acceptable foods. If the steak is well cut, broiled shortly before mess call, and served while it is still hot, more will be eaten, it is true, than if it is fried some two hours before it is to be eaten and if it is found, when served, to be tough, cold, permeated with grease, and altogether unpalatable. Assuming that it is well cooked and properly served the cost of the increased quantity eaten is in part offset by decreased waste and lessened amounts of other foods eaten in substitution therefor, but the unbalanced margin of expense thus involved in better satisfying the crew goes to make for contentment which, in turn, makes it easier to feed the crew most of the time with a relatively low percentage of waste and, on the whole, with a more economical menu. Success breeds success and if the ship has the reputation of feeding well it is correspondingly easier to satisfy the desires of the crew. On the other hand, the habit of complaining about the food spreads, and, although many of the complaints may not be justified, they tend to stir up discontent that will prove embarrassing to the commissary and a handicap in planning good meals on a proper cost basis.

If the commissary does not follow the desires of the crew it will be found that considerable quantities of the different foods prepared will not be eaten. Inasmuch as the sum that can be spent for food is more or less fixed this means that less money will be available under such poor management than could be spent for foods that the men would appreciate and fully consume within reasonable limits. From the viewpoint of hygiene the object is to provide an abundance of good food, but for obvious reasons the economic problem is also important.

An abundance of good food can not be provided within a reasonable ration cost unless all unnecessary waste is curtailed. As an example of how things often work out when through carelessness, or for other reasons, the commissary does not follow the varying preferences of the crew, let it be supposed that ham and eggs are served for breakfast on a certain morning and that ham has frequently appeared on the menu in the recent past as boiled ham, baked ham, and fried ham, at various meals, to such an extent that many of the men have become tired of it. Although ham and eggs ordinarily make a most acceptable Navy breakfast, in this instance much of the ham that was cooked would not be eaten, especially if it was not perfectly cooked, but there would be an insistent demand for more eggs, which in all probability would be satisfied. To do this it becomes necessary to spend money that would otherwise be available for the purchase of desirable food for a subsequent meal that could be used advantageously in keeping the men satisfied. There has been an economic loss, complaints have been provoked, and money has been spent to accomplish an object that could better have been accomplished in the first place without additional cost by serving something other than ham. If this sort of thing happens frequently, the vessel will become known as a poor-feeding ship, although the cost of the ration may even be higher than for other ships that are said to feed well. Of course, this is only one of the many methods by which a reputation for poor feeding can be acquired. The serving of excessively large portions of certain foods that are acceptable enough in reasonable amounts works out in the same way.

A good many men in the Navy are inclined to push spinach and certain other vegetables aside and not eat any of the portion served. Doubtless with a little educational effort such men could be induced to eat their share of such articles. Many a man who has not been accustomed to eating the spinach placed before him has found, upon learning of its nutritional advantages, that it is in fact a very likable food. This is true also of certain other leafy vegetables, some of which may be served uncooked in the form of salads. A liking for such things may be cultivated. Much, of course, depends on the cooking or preparation and manner of serving. Provided the ration is skillfully handled, the food reasonably well cooked, and served as attractively as the limitations Navy mess gear permit, the men can often be induced, when carefully tried out, to accept some foods which are commonly regarded as altogether unacceptable. For example, creamed soups or soups containing a certain amount of milk may be mentioned. It is usually considered that the crew will not be satisfied with a soup unless it is of such a character that it alone might serve as a full meal, at least so far as fuel value is concerned.

It is of course desirable to include in the diet a fair proportion of protective foods even though the dishes as prepared have comparatively little fuel value. Constipation is quite common among the enlisted men, and, while irregular habits and the concentration of toilet facilities far away from where the man may be at the time he would be likely to evacuate his bowels on a regular schedule are also factors, improper diet is an important causes of constipation on board ship. In many cases the food eaten is, on the whole, deficient in vegetable fiber, indigestible cellulose, which serves to give bulk to the feces and acts as roughage to stimulate normal peristalsis. In many cases more water could be taken in, and with the food, to good advantage. Another advantage of vegetables and fruits which has a high water content and furnish cellulose is that they are relatively rich in mineral elements. The diet of the enlisted man on board ship can easily be deficient in some of the essential inorganic constituents even though he stuffs himself with the foods which he has gotten into the habit of eating almost exclusively. The body of the young blue jacket needs plenty of calcium and he may readily deprive himself of this mineral. The lack of fresh milk on board ship is a great handicap in furnishing the optimum amount of calcium to the average individual in utilizable form, not to mention milk as a means of inducing many men to take more water as a part of the food in place of large quantities of coffee containing very little evaporated milk. The milk proteins of course are of the highest biological value, and if milk proteins are ingested regularly the total amount of protein required to fulfill all physiological requirements need not be anything like as great as when a mixture of proteins, some of which are lacking in certain essential amino acids, are fed. Reconstructed milk would serve admirably on board ship to take the place of fresh milk while at sea, and it is probable, with growing recognition of the importance of regularly including milk in the dietary, that, eventually, it will be found practicable, in the large ships at least, to afford the necessary ice machine capacity and space for the reconstructing machinery, particularly since experience on board the hospital ships has demonstrated that it is entirely practicable to furnish milk of acceptable quality in this way at a reasonable cost, and with a comparatively small space devoted to the purpose. Shortly after the World War, Capt. F. L. Pleadwell, Medical Corps, United States Navy, then fleet surgeon of the United States fleet, strongly recommended that battleships be equipped to furnish reconstructed milk in the general mess. The Bureau of Medicine and Surgery of course heartily indorsed his recommendation, but nothing came of it.

Limited capacity of ice machines is one of the difficulties to be overcome, and doubtless it is not yet universally appreciated that

reconstructed milk is not in any sense a food substitute. Meanwhile, medical officers should impress on supply officers the importance of taking advantage of every opportunity to provide fresh milk as an article of diet in the general mess when in port. This is true also, of course, of green vegetables and fruits which the men will eat in sufficient quantities, when generously served, to supply an abundance of essential inorganic matter as well as cellulose which, when obtainable in palatable food, materially helps to overcome a tendency to constipation. Preserved fruits and vegetables are not lacking in these respects, but, everything considered, many of the men are not likely to eat as high a proportion of foods relatively rich in ash and fiber when fresh leafy vegetables and fruits are not available as they would in port if such articles were furnished to the limit of acceptability. Not infrequently, when fresh stuff is served, the portions are small and the average man actually may not get as much of any desirable article as he would ordinarily eat of the equivalent canned food. Thus, too often, even while the ship is at a navy yard, the diet, comprising food actually eaten, still tends to be deficient in fiber and mineral elements.

Many men on board ship do not drink enough water regularly with their meals and between meals. From the standpoint of hygiene it would be very desirable if drinking glasses or cups, if considered more suitable, could generally be provided and water regularly served with the meals. As things are, many men drink large quantities of black coffee, as much as two quarts daily, and some drink even more. Although there is no evidence of a statistical character to show that the men suffer in health, it is at least doubtful if such large amounts of a beverage containing so active a drug as caffeine can be taken continuously without damage.

Fuel Values of the Navy Ration

It is not very practical to calculate the caloric value of the Navy ration as authorized by law. The ration, as described in the law, consists of a number of components and equivalent quantities of other articles some of which are expressed in general terms as fresh meat, fresh fish, fresh vegetables, etc. The fuel value of the ration in any given organization will naturally depend upon the bills of fare; that is, upon the foods actually issued, or, in other words, upon the quantities of different foods actually used.

So far as the ration law is concerned it may be said that by selecting from the list of components and their equivalents in each group the article or articles having the greatest caloric value on the one hand and those having the least value on the other hand the total fuel value of the ration as available for issue might range

from about 7,350 calories per man per day to a minimum of about 3,350 calories.

Gatewood estimated the usual Navy ration as consumed to consist of 142 grams of protein, 192 grams of fat, and 492 grams of carbohydrates, altogether having a utilizable fuel value of 4,256 calories with the nutritive ratio, 1 to 6.7. At best such a calculation must be a guess. The estimation serves no practical purpose in routine work, for the fuel value of the ration will depend upon the kinds of foods served. Some of the most valuable foods from the standpoint of nutrition, and likewise some of the most acceptable foods, have relatively low fuel value.

The essential facts relating to dietary needs can not be compressed into generalities of this sort. The total fuel value and the percentages of proteins, fats, and carbohydrates may give little evidence as to whether the diet is compatible or incompatible with health. On board ship it is not necessary to know what the fuel value of the ration is. It is practically sufficient to know that enough food is being served to avoid complaints. Planning a diet for an individual is a very different matter. There it may be important, according to the disease or physical condition of the patient, to know how much protein, fat, and carbohydrate matter is being consumed and what the total caloric value of the diet is. But in feeding a group of healthy men it is not possible to know how much or how little any given individual eats of several foods served. It is possible only in a rough way by estimating total waste to calculate what the average man consumes. The nearest approach that can be made ordinarily is to calculate the fuel value and nutritive ratio of the ration as issued; that is, of the foods expended or used. After a deduction is made for total waste the remaining calories presumably represent those available to the crew for consumption.

It is only in the study of special problems that it becomes necessary to calculate the fuel value of a ration. For example, in planning the food supply for an expedition which must depend entirely, or for the most part, upon the food taken with it, it becomes important to know that sufficient protein of good biological quality will be available during the whole period of separation from sources of supply and that the total fuel value will be sufficient to meet all foreseen or possible energy requirements, considering climate and the amount of muscular work to be performed. Even under such circumstances it would not be necessary to make these calculations if, by previous experience under similar conditions, it had been determined what foods and how much of them should be taken along. In times of food shortage, as happened in some countries during the

World War, estimation of the fuel value of all food probably obtainable in a given future period in terms of calories available per capita per day may become an important activity of the Government. It may be very important to know that the food available for a body of troops in the field will surely furnish the required number of calories for the hard work that is likely to be required of them—perhaps 5,000, 6,000, or more calories per man per day if loss of weight is to be avoided. It is not so necessary that those in the field consider the number of calories furnished—appetites will regulate the amount of food that should be provided—but the home Government faced with difficulties in transporting foods, possibly across seas, hampered by enemy submarines and other opposing forces, must carefully consider fuel requirements in relation to the kind of service to be performed by the troops at the front. Barring expeditions, conditions in the Navy are different. There are experience tables to indicate the quantities of foods required for ships of various types. The crew of a ship includes some men who perform hard muscular work, others of whom only moderate physical exertion is required, and some whose duties call for comparatively few calories. With mobile troops all members of the command must alike exert themselves and difference in food requirements is due principally to differences in size and weight of individuals.

It is not helpful ordinarily to calculate calories in planning bills of fare for groups of individuals having widely different fuel needs. More practical guides are experienced regarding the quantity of food required, acceptability of the different foods available, and the varying preferences of the men. If these guides are followed, and at the same time care is taken to include the protective foods, milk, eggs, leafy vegetables, and fruits, as frequently and in as large amounts as cost, availability, acceptability, and the varying preferences of the men will permit, the ration will be as well balanced as it can be under the circumstances. Nevertheless, when critically examining a ration as it has been issued over a definite period, calculation of the fuel values of the different foods used is almost a necessary step in the course of analysis looking toward the discovery of possible defects in balance and deficiencies in essential dietary factors.

Analysis of the Ration as Actually Issued on Board Ship

During the past year the Bureau of Supplies and Accounts submitted to the Bureau of Medicine and Surgery a list of foods and foodstuffs with the weight of each item stated in pounds. This list was compiled from the returns of three battleships, comprising alto-

gether 241,656 daily rations covering a period of about two months. Varying conditions of service activities were represented. Some of the time was spent in port, and some of it at sea, so that the analysis of these returns probably gives an approximately correct answer to the question "What is the usual make-up and fuel value of the Navy ration as issued?" The findings were as follows:

All foods and foodstuffs as issued per capita per day.—(Average daily issues, three battleships, during a period represented by 241,656 rations):

	Grams	Calories
Proteins	159.0	636
Fats	199.4	1,795
Carbohydrates	548.2	2,193
Total nutrients	906.7	4,624

The total weight of food was 5.47 pounds per man per day.

Of the total utilizable calories obtainable from the food as issued, 14 per cent were protein, 39 per cent fat, and 47 per cent carbohydrate calories. The nutritive ratio was accordingly 1 to 6.14.

The above values represent the rations as issued. To estimate the number of calories consumed it is necessary to make an allowance for total waste. If 20 per cent be allowed for waste 3,700 calories per man per day were consumed, and if the waste amounted to 25 per cent the fuel value was 3,469 calories.

It is probable that proteins, fats, and carbohydrates were not wasted in equal amounts. Of course, each gram of protein or of carbohydrate wasted means the loss of only 4 calories, whereas each gram of fat wasted means the loss of 9 calories. It is difficult to estimate what the relative percentage losses were for several reasons. Among other things some of the fat lost was pure fat and some of the carbohydrate lost was pure sugar or starch, whereas the protein lost was a constituent of meat, eggs, fish, flour, etc., and the protein containing foods wasted also contained fat or carbohydrate. Possibly the greatest relative loss was in fat calories and the least in carbohydrate calories, with the percentage loss of protein calories somewhat between. It might, therefore, be assumed that, of the total calories in the food eaten, something less than 14 per cent were protein calories, considerably less than 39 per cent were fat calories, and something more than 50 per cent were carbohydrate calories.

The sources from which the proteins in these rations were derived are of interest. These may be grouped as follows:

	Per cent of total proteins issued
Meats, including poultry	44.74
Cereal seeds	24.87
Leguminous seeds	8.27
Tubers	6.43
Eggs	4.71
Milk	4.31
Fish and shell fish	3.19
Leaves (vegetable)	1.74
Fruits	.81
Roots	.27
Bulbs	.22
Nuts	.09
All others	.35
All sources	100.00

There can be no doubt that all requirements for proteins were satisfied with this variety in the amounts furnished. Allowing for almost 25 per cent waste of protein the total amount of protein available for consumption must have amounted to more than 120 grams per man per day. But inasmuch as the proteins were derived largely from foods that contain little, or relatively little, calcium the question at once arises whether the ration as a whole was not deficient in calcium.

Calculation of the total amount of calcium available in the foods as issued seems to indicate quite definitely that the rations as served in these three battleships were deficient in this essential element. And, therefore, it is probable that diets of enlisted men in the Navy while serving on board ship in general are, or tend to be, deficient in calcium. There is probably close relationship between such deficiency and dental diseases and conditions, but, apart from any particular consideration, and acting on general hygienic principles, a deficiency in calcium should not be permitted because, in view of the complete elasticity of the Navy ration, such a defect can be avoided in preparing bills of fare afloat as well as ashore.

The following table indicates the quantities of the different foods issued in the above-mentioned three battleships during a period of about two months. In order that the table may be conveniently used for reference the amount of each food issued is expressed in the first column in pounds per 1,000 men per day and in the second column in terms of grams per man per day. The amounts of calcium and phosphorus supplied by each food are estimated in relation to utilizable calories. Thus, refuse is excluded and the figures represent only the calcium or phosphorus contained in the edible portions of the different foods listed. The values for calcium and phosphorus

were taken from Sherman's book, "Chemistry of Food and Nutrition," 1918 edition. The amounts of calcium and of phosphorus are also indicated in terms of each per man per day estimated to have been contained in each of the foods which, it should be remembered, were foods issued and accounted for in the ration returns. Only a part of the food thus accounted for was eaten. For the sake of greater accuracy in estimating the total amounts of these elements furnished in the rations, the total weight of each of the foods used during the whole period embracing 241,656 man-day rations was taken as the basis for arithmetical calculation. In other words, the total amount of each element supplied by all the various foods and foodstuffs issued during the entire period was first estimated. This, in the case of calcium, amounted to 171,715.2 grams, or, reduced to an average daily figure, 0.710577 gram per man per day. Before considering calcium requirements it may be well to glance at the table which is as follows:

Foods actually issued in three battleships comprising 241,656 man-day rations—foods by weight and estimated amounts of calcium and phosphorus furnished by each

Article	Pounds per 1,000 men per day	Grams per man per day	Calories per man per day	Calcium per 100 calories	Calcium per man per day	Phosphorus per 100 calories	Phosphorus per man per day
Crackers, soda	17.19	7.80	32.26	0.006	0.001936	0.025	0.008065
Bread, wheat	292.03	132.58	345.90	.011	.038049	.035	.121065
Flour, wheat	373.61	169.62	606.39	.006	.036383	.026	.157662
Corn meal	9.10	4.13	14.69	.005	.000734	.053	.007787
Rolls	1.45	.66	1.97	.011	.000216	.035	.000688
Bacon, tinned	5.11	2.32	7.33	.001	.000126	.032	.002349
Bacon, sugar-cured	36.97	16.78	95.77	.001	.000876	.020	.016284
Beef, corned, tinned	27.46	12.47	33.69	.005	.001843	.097	.032807
Beef, chipped, tinned	7.40	3.36	6.82	.014	.000752	.204	.013977
Salmon, tinned	14.86	6.75	9.81	.007	.000763	.153	.015098
Sardines, tinned	.38	.17	.36	.007	.000025	.154	.000571
Sausage, Vienna	9.73	4.42	11.34	.004	.000456	.074	.008478
Codfish, tinned	7.15	3.25	3.63	.014	.000514	.280	.010174
Luncheon meat	31.05	14.10	35.07	.006	.002158	.114	.040115
Ham, sugar-cured	96.81	43.95	157.00	.002	.003722	.043	.069175
Sausage, bologna	21.17	9.61	23.97	.004	.001004	.077	.018657
Frankfurters	45.13	20.49	51.85	.004	.002341	.083	.043511
Beef, corned, fresh	31.97	14.51	39.22	.003	.001179	.056	.021905
Beef, fresh	374.62	170.08	337.26	.004	.014501	.079	.269511
Pork, fresh	88.07	39.98	113.84	.002	.003200	.050	.059482
Veal, fresh	71.46	32.44	37.99	.007	.002841	.138	.052810
Fowl	30.93	14.04	26.42	.006	.001576	.110	.029290
Sausage, pork	54.06	24.54	110.11	.001	.001808	.030	.033604
Turkey, frozen	32.57	14.79	33.77	.004	.001347	.074	.025026
Liver, frozen	27.39	12.44	14.76	.009	.001457	.183	.027074
Fish	45.73	20.76	13.14	.011	.001553	.233	.030743
Eggs	125.84	57.13	77.75	.045	.034990	.122	.094872
Beans, Navy, dried	86.71	39.36	135.66	.047	.063761	.137	.185857
Beans, lima, dried	19.02	8.64	30.18	.020	.006035	.096	.028970
Beans, kidney, dried	14.90	6.76	24.33	.040	.009731	.143	.034788
Beans, string, tinned	27.80	12.62	2.59	.110	.002846	.126	.003260
Beets, tinned	15.98	7.25	2.88	.064	.001843	.084	.002419
Corn, tinned	40.17	18.24	17.87	.006	.001072	.102	.001854
Peas, tinned	44.99	20.43	11.32	.026	.002942	.120	.013578
Spinach, tinned	8.17	3.71	2.07	.281	.005807	.285	.005890
Pumpkin, tinned	8.70	3.95	1.41	.089	.001257	.229	.003235
Tomatoes, tinned	130.93	59.44	13.43	.050	.006717	.113	.015181
Potatoes, Irish	1,122.58	509.65	340.95	.016	.054553	.069	.235260
Onions:							
Dried	38.48	17.48	7.67	.069	.005293	.093	.007133
Fresh	44.80	20.34	5.06	.069	.003494	.093	.004709
Potatoes, sweet	162.87	73.94	72.91	.016	.011665	.037	.026976
Pumpkin, fresh	3.48	1.57	.21	.089	.000186	.229	.000480
Cabbage, fresh	132.80	60.29	16.04	.143	.022933	.092	.014754

Foods actually issued in three battleships comprising 241,656 man-day rations—foods by weight and estimated amounts of calcium and phosphorus furnished by each—Continued

Article	Pounds per 1,000 men per day	Grams per man per day	Calories per man per day	Calcium per 100 calories	Calcium per man per day	Phosphorus per 100 calories	Phosphorus per man per day
Cauliflower	29.32	13.31	4.06	0.403	0.016361	0.200	0.008119
Carrots	18.23	8.27	2.90	.124	.003592	.101	.002926
Celery, trimmed	8.99	13.16	1.96	.421	.008256	.201	.003941
Corn on cob	24.95	11.33	4.44	.006	.000266	.102	.004528
Peppers, green	2.83	1.28	1.04	.034	.000352	.145	.001505
Turnips	40.78	18.52	5.05	.161	.008137	.117	.005913
Cucumbers, fresh	8.68	3.94	1.10	.090	.000989	.191	.002099
Radishes, fresh	4.04	1.84	.38	.073	.000274	.098	.000368
Tomatoes, fresh	17.33	7.87	1.79	.050	.000896	.113	.002026
Lettuce	1.09	.50	.08	.224	.000175	.224	.000175
Squash	13.24	6.01	1.36	.039	.000529	.035	.000475
Rice	22.76	10.33	36.24	.001	.000362	.027	.009784
Cornstarch	9.05	4.11	14.79				
Hominy grits	8.69	3.95	13.99	.002	.000279	.027	.003777
Oats, rolled	9.64	4.38	17.38	.017	.002955	.099	.017210
Barley	2.07	.94	3.34	.005	.000188	.051	.001701
Tapioca	2.48	1.13	2.67	.004	.000106	.025	.000666
Coconut	1.12	.51	3.39	.006	.000203	.143	.004848
Raisins	3.33	1.51	4.66	.019	.000884	.038	.001769
Citron	.04	.02	.06	.037	.000023	.010	.000006
Apricots, tinned	17.27	7.84	5.71	.023	.001312	.044	.002511
Peaches, tinned	13.75	6.24	2.93	.038	.001112	.057	.001668
Pears, tinned	10.20	4.63	3.52	.024	.000843	.041	.001441
Prunes, tinned	7.85	3.56	3.28	.018	.000590	.035	.001148
Pineapple, tinned	8.35	3.79	5.82	.041	.002387	.064	.003726
Jams, tinned	14.71	6.68	20.92	.037	.007739	.028	.005862
Apple sauce	27.62	12.54	19.67	.004	.000786	.006	.001179
Apple butter	2.41	1.09	1.72	.012	.000206	.020	.000343
Mincemeat	10.97	4.98	13.95	.003	.000418	.049	.006835
Apples, fresh	192.94	87.59	41.26	.012	.004950	.020	.008251
Bananas	14.64	6.65	4.26	.009	.000382	.031	.001319
Cantaloupes	32.38	14.70	2.88	.044	.001258	.238	.001094
Cranberries	9.61	4.36	1.95	.039	.000762	.027	.000527
Lemons	3.25	1.48	.46	.081	.000369	.049	.000222
Oranges	168.59	76.54	28.55	.088	.025123	.040	.011419
Grapefruit	38.84	17.63	3.88	.040	.001551	.036	.001396
Tangerines	13.22	6.00	2.18	.088	.001922	.040	.000873
Casaba melons	3.24	1.47	.24	.044	.000103	.038	.000089
Grapes, fresh	1.79	.81	.56	.019	.000105	.032	.000177
Watermelons	5.96	2.71	.34	.039	.000131	.010	.000033
Lard	70.98	32.22	290.01				
Cocoa	5.01	2.27	11.21	.023	.002579	.143	.016035
Coffee	71.03	32.25					
Tea	3.19	1.45					
Milk, evaporated	111.77	50.74	84.69	.189	.160066	.146	.123649
Butter, fresh	83.41	37.87	291.20	.002	.005823	.002	.005823
Butter, tinned	24.09	10.94	84.11	.002	.001682	.002	.001682
Cheese, fresh	4.78	2.17	9.54	.212	.020218	.156	.014877
Cheese, tinned	6.54	2.97	13.05	.212	.027675	.156	.020364
Macaroni	14.90	6.76	24.22	.006	.001453	.040	.009687
Mustard	.61	.28					
Pepper, black	.95	.43					
Pickles	12.27	5.57	1.34	.090	.001202	.191	.002552
Sauerkraut	14.26	6.47	1.72	.143	.002452	.092	.001578
Salt	31.13	14.13					
Sirup	12.40	5.63	16.08	.037	.005947	.003	.000482
Sugar, granulated	266.64	121.05	484.20				
Sugar, powdered	.74	.34	1.35				
Vinegar	10.03	4.55		[1] .016	.000728	[2] .013	.000591
Catsup, tomato	30.39	13.80	7.87	.208	.016360	.452	.035552
Sauce, Worcestershire	1.55	.70					
Salad oil	14.46	6.56	59.08				
Baking powder	2.07	.94					
Baking soda	.55	.25					
Yeast	5.21	2.37	3.18				
Extract, lemon	.79	.36					
Oysters	6.73	3.06	.75	.106	.000797	.306	.002303
Nuts, mixed	3.10	1.41	4.68	.026	.001217	.048	.002248
Ice cream	20.44	9.28	15.22	.020	.003135	.094	.014304
Cake	4.55	2.07	6.08	.056	.003405	.082	.004985
Olives	2.23	1.01	2.22	.041	.000910	.004	.000088
Clams	2.06	.94	.68	.229	.001566	.100	.000683
	5,466.74	2,481.89	4,623.93		.710577		2.174555

[1] Calcium —.016 per cent.

[2] Phosphorus —.013 per cent.

Calcium constitutes about 2 per cent of the body weight. The proportion is greater than that of any of the other inorganic elements. Sherman states that the ordinary mixed diet of Americans and Europeans, at least among dwellers in cities and towns, is probably more often deficient in calcium than in any other chemical element. Lusk states in his book, "The Elements of the Science of Nutrition," 1917 edition, that the minimum amount of calcium needed in the daily diet to establish calcium equilibrium is unknown. He cites the work of Bertram, which would seem to indicate that a man can be maintained in equilibrium when the diet contains 0.4 gram expressed as calcium oxide. Herxheimer found that a man attained equilibrium with the equivalent of 0.86 gram calcium oxide. Lusk mentions that German authorities state that a man requires about 1.5 grams in terms of calcium oxide or 1.07 grams of calcium. He quotes Tigerstedt's statement that the diet of Finns contains between 2 and 6 grams of calcium oxide daily and states that in contrast with this, the ordinary American diet of the average inhabitant of the Eastern States, as studied by Sherman, Mettler, and Sinclair presents a sorry spectacle. The diet of the average bluejacket in the Navy, at least while he is serving on board ship, probably would present a much sorrier picture.

Quoting from Sherman, Herbst found that boys between 6 and 14 years of age were storing 0.21 to 0.39 grams of calcium per capita per day. "These boys consumed about three to four times as much calcium in proportion to their weight as is required for the maintenance of men." Sherman concluded that the food of a family should furnish at least 0.67 gram of calcium per capita per day but admitted that this is less than is advocated by a number of writers who had recently studied the subject. As Sherman states, more attention should be paid to the choice of such foods as will increase the calcium content of the dietary. "The use of more milk and vegetables with less meat and sugar will accomplish this and usually improve the diet in other directions as well." "By far the most practical means of insuring an abundance of calcium in the dietary is to use milk freely as a food." Everything considered, the average adult should have available daily in his food not less than 1 gram of calcium.

Taking up again the discussion of the ration returns from the three battleships, it is clear that considerably less than 0.71 gram of calcium per man per day was available for ingestion. With all foods considered together the total waste was probably between 20 and 25 per cent of the nutrients contained in the edible portions of the foods listed in the returns. Calcium was wasted along with the nutrients, proteins, fats, and carbohydrates, but in just what pro-

portion can not be determined. There are many ways in which food may be wasted, as we have seen. In addition, a good deal of calcium is dissolved out of the food in cooking, especially in boiling. That is, much of it is lost if the water in which the food was boiled goes to waste, as is often the case when meats and vegetables are boiled. Of course in cooking soups and stews where the water is retained as a part of the prepared food the calcium is retained, but very often in Navy general messes foods are simply boiled in water as the means of applying heat in lieu of baking or roasting. It seems very conservative in studying these rations to estimate that at least 20 per cent of the calcium contained in the edible portions of the foods was lost in sundry forms of waste. Deducting 20 per cent of 0.71 gram, it appears that the calcium consumed could not have been more than 0.57 gram per man per day.

This average figure is much too low. Many of the enlisted men are young and growing boys, and their calcium requirements are greater than those of mature adults. Again, the estimated average per capita per diem does not reveal how great the deprivation may have been, for many individuals who by their own unwise selection of foods from among those prepared and served further increased the deficiency in their cases. All things considered, it seems reasonable to conclude that the food served on board the three battleships during the period covered by the returns was so lacking in calcium that many individuals at least did not receive enough to maintain them in equilibrium. On this score alone the general mess dietary was badly defective.

It is generally considered that calcium in inorganic compounds, as contained in drinking water, is utilizable. In what proportion and to what extent, is a question that does not enter into this problem, for the personnel serving on board naval vessels seldom get any appreciable amount of calcium in the water, and part of the time they drink nothing but distilled water, and likewise distilled water is used in cooking. As Sherman points out, unless a very "hard" water be used for drinking, it is unlikely that the lime from this source will cover more than a small part of the calcium requirement, and in any event it is probable that the losses of food calcium in cooking may fully offset the calcium obtained from the drinking water.

In the simplified diets for animals used in feeding experiments an inorganic compound of calcium is included in the necessary salt mixture which must be added to the nutrients. Calcium carbonate is often used. It appears to fulfill all requirements. It might therefore be considered an easy matter to correct any deficiency by putting calcium into the food as it is cooked or by substituting a salt mixture for table salt on board ship. However, that is not a natural

way of feeding human beings and the apparent deficiency in calcium, a defect in the diet which can readily be calculated, is only one among several defects that probably exist when foods that naturally contain this element are not eaten in proper proportionate amounts. A diet that is deficient in calcium is deficient in the protective foods which are of importance for their ash content in general, for vitamins, and in the case of milk for the biological value of its proteins.

It is far more rational to prepare bills of fare that will correct the deficiency. In the rations of the three battleships referred to, although milk and milk products furnished only 4.3 per cent of total proteins, they nevertheless furnished 30.3 per cent or almost one-third of the available calcium. The importance of increasing the amount of milk used is obvious. It should require little ingenuity on board ship to make more use of evaporated milk or powdered milk. More can be added to the coffee than perhaps is often the case, and more can be used in cooking, by serving cream soups occasionally, and by using milk in other ways along with and in place of flour. Cheese may be served more often and in somewhat greater quantities to good advantage.

Eggs should be served as often as sources of supply and keeping qualities permit. There is little doubt that eggs would be acceptable more often than they are usually issued while the ship is away from a domestic port, and sometimes they could be served to the crew more often than they are while in the home port.

It should be possible to use more of the roots that contain considerable calcium. Carrots and turnips might well be used to a greater extent in stews and in old-fashioned soup. Bones for soup stock are always available, and if not used in this way they go for refuse. Soups and stews are valuable because the mineral matter from all ingredients is retained in the food. More beets could usually be issued to good advantage.

Among the leaves, cabbage and spinach are, of course, valuable. Doubtless cabbage is often not issued to the limit of acceptability or in as many ways as it could be with a little more thought in planning meals. All the leaves and stalks commonly used for food, spinach, asparagus, celery, lettuce, string beans, cauliflower, dandelion greens, beet tops, and the fruits and berries are valuable for the mineral elements they contain and most of them for vitamins.

While the cereal seeds are not to be compared with milk or the leafy vegetables, or some of the fruits, with regard to content of calcium and other essential mineral elements, it is nevertheless worth while to make use of material representing the whole grain, such as oatmeal or whole wheat, for breakfast food, instead of patent

breakfast foods composed of cereal substance which has been freed from the germinal substance and wrappings, so that practically all of what little protective matter the seeds contained originally has been lost. The cereals can be dispensed with altogether in a well-balanced diet, and in many instances dietaries would be improved by greatly reducing the frequency and extent to which they are employed. When fresh milk is available a cereal breakfast food may serve usefully to induce an individual to use more milk than he otherwise would. In themselves the cereals offer calories derived from proteins in considerable amount as well as energy from carbohydrates.

As indicated above, cereal seeds furnished nearly one-fourth of the total proteins in the rations analyzed, and it is probable that such a considerable proportion is usually so furnished in Navy general messes. These proteins are much below those of milk, eggs, and meats in growth promoting qualities. The tendency is, and it often will be the case, for the total amount of protein ingested to be greater than necessary when the diet is overweighted with foods derived from cereal seeds. This may seem paradoxical. The reason is that such protein is incidentally added to that furnished by meats, fish, eggs, etc., of which the individual by instinct, habit, or appetite eats heartily even though he eats cereal foods at the same time. Bread is one of the cereal foods. There is of course no reason why a moderate amount of bread should not be eaten regularly, whether it be ordinary white bread or bread made principally from whole wheat flour; but a diet overweighted with bread will obviously be unbalanced in several particulars. The dependency upon bread resulting from custom and habit, as well as the general availability and keeping qualities of wheat flour, relatively low cost, etc., is almost universal, and this dependency is a factor that must be taken into consideration. Inasmuch as many individuals are inclined to take as much, or nearly as much, cereal food in the form of bread as can be included in a well-balanced diet, there is little room left for prepared breakfast foods and other derivatives of cereal seeds.

The calcium-phosphorus ratio in the battleship rations.—It is not possible to state just how much phosphorus the normal daily diet of the average man should contain. Phosphorus eliminated in the urine, plus that eliminated in the feces, is largely a measure of the metabolism of nucleo-proteins. Phosphorus compounds are essential to all tissues of the body, and the growth of new tissue involves storage of phosphorus along with storage of amino acids in the form of protein. Apart from requirements depending upon protein metabolism, phosphorus metabolism presents a separate problem. It

is possible by experimental study to fix for a given individual certain limits within which the amount of phosphorus required for equilibrium must lie. Sherman states that when the intake approximates this required amount it is justifiable to regard the output as an indication of the normal nutritive requirement. He continues, "Study of the data of 93 such phosphorus balance experiments upon 27 subjects—21 men and 6 women—has shown a range of 0.52 to 1.75 grams, with an average of 0.96 gram phosphorus (2.20 grams P_2O_5) per 70 kilograms of body weight per day. This corresponds with the average requirement of 50 grams protein per day per man of 70 kilograms as estimated * * *. Allowing 50 per cent above the bare minimum would give a phosphorus 'standard' of 1.44 grams (3.30 grams P_2O_5) corresponding to a protein 'standard' of 75 grams. In 150 American dietaries of families or larger groups believed to be fairly representative, the estimated amount of phosphorus furnished per man per day was below 0.96 gram in seven cases, while in no case was there less than 50 grams of protein per man per day."

A freely chosen diet does not always furnish an abundance of phosphorus compounds. Sherman concludes that food habits are more likely to lead to a deficiency of phosphorus compounds than to a deficiency of protein in the diet, and it is not improbable that many cases of malnutrition are really due to an inadequate supply of phosphorus compounds.

The amount of phosphorus calculated for the battleship rations, using Sherman's figures, was 2.17 grams per man per day in the foods issued. Clearly, there was a slight excess rather than a deficiency. The large amount of course was due to the high protein content of the ration and especially to the liberal quantities of meats issued. McCollum has stated, "Meat is essentially lacking in fat soluble A. It does, however, contain phosphorus, and but little calcium, and serves to change the ratio between these elements in the diet." This change in ratio, he has shown, is of great importance in the etiology of rickets and in the production of dental defects and diseases.

About five years ago, McCollum, Simmonds, Shipley, and Park, in connection with studies on experimental rickets, wrote as follows: "Apparently in the rat the profound disturbances in the deposition of lime salts in cartilage and bone and the changes in the cells of those tissues which give rise to the pathological complex known as rickets may be produced by disturbances in the diet of the optimal ratio between calcium and phosphorus in the absence of an amount of an organic substance contained in cod liver oil sufficient to prevent them. It would seem from the results of a large number of experiments which will be published in detail soon, that in so far

as calcium and phosphate are concerned, the physiological relation in the diet between the two is of infinitely greater importance in insuring normal calcification than is the absolute amount of the salts themselves."

It has since been shown by others that the organic substance supplied by cod liver oil is the so-called vitamin D, or one may say, sunlight. Just what the optimal ratio between calcium and phosphorus in the diet is has not been established.

In a later paper already referred to above, which was published in the June, 1922, number of the Johns Hopkins Hospital Bulletin, McCollum, Simmonds, Kinney, and Grieves, reported the results of many experiments which had shown that close relationship exists between these factors—vitamin D, calcium, phosphorus, and the ratio of calcium intake to phosphorus intake—and tooth development and tooth preservation. By way of summarizing the results of the experiments on which they based their conclusions they included the following paragraphs:

"These reports have shown that the internal structure of the skeleton of the rat could be changed at will by varying the ration which the animals received. In other words, bone is an extremely labile tissue and is readily influenced by nutritional environment.

"Some of the faulty diets which were studied produced rickets, often of an exaggerated type; others caused osteoporosis. Still others resulted in the development of the peculiar lesion which has been called osteosclerosis.

"A study of the effects of these diets on the skeleton would indicate that the growth of the skeleton was dependent on at least three substances: (1) an organic substance present in certain fats which is not identical with the antixerophthalmic fat soluble A; (2) calcium, and (3) phosphorus.

"If the organic factor is low in, or missing from, a diet the structure of the osseous tissue is dependent on the ratio between the above mentioned ions in the diet and the circulating blood.

"If calcium is present in amounts equal to, or exceeding, those which would be optimal for growth and function if all other factors are satisfactory but the phosphate ion is low, rickets is produced. The same disease results when the converse relation exists between the two ions.

"In other words, diets which contain optimal or excessive amounts of calcium but are low in phosphorus and the organic factor, produce rickets.

"Rickets also results from feeding diets low in calcium and the organic factor, although phosphorus be present in satisfactory amounts.

"Diets which are satisfactory except that they are deficient in the organic substance result in osteoporotic but perfectly calcified bone.

"Diets which have a comparative deficiency in calcium but are very high in phosphorus and in the organic substance, produce so-called osteosclerosis, with large numbers of small imperfectly calcified trabeculæ.

"Diets deficient in calcium alone produce a pseudorachitic condition with overproduction of osteoid."

Among conclusions regarding the dental defects and diseases experimentally produced in the rats were the following:

The percentage of oral defects was greatest in the rats that were fed diets deficient in proteins, calcium, and vitamin. The next highest incidence was among rats fed on diets low in calcium. The rats having the third highest percentage of tooth damage were those fed diets that were low in both calcium and vitamin.

The oral tissues were the least damaged by:

Diets high in calcium but low in vitamin.

Diets high in both calcium and cod-liver oil.

Diets low in calcium but high in cod-liver oil.

No caries-like lesions, pulp exposure, or defects of osteodentin, attacking tissue or maxillæ occurred in stock rats fed on the laboratory standard balanced diet.

The relation of the antineuritic vitamin B and the antiscorbutic vitamin C was not discussed in the report, although doubtless a deficiency of antiscorbutic substance in the diet of a man would be a factor in the production of oral disease. The rat is able to synthesize this substance. From a study previously made by Shipley, McCollum, and Simmonds and reported in the Journal of Biological Chemistry, October 11, 1921, rats fed on a diet complete except for the absence of the antiberiberi factor develop lesions in the bones which are essentially identical with those seen in guinea pigs suffering from acute and uncomplicated scurvy. Rats confined to the same diet supplemented with water soluble B do not show these changes.

Taking up again the discussion of the battleship rations, it is clear from the table showing the make-up with respect to calcium and phosphorus that calcium must have been low in the average man's diet and no doubt many men had a very low intake of calcium. The intake of phosphorus, on the other hand, was somewhat high for the average man and doubtless considerably in excess for individuals who subsisted largely on meat, bread, potatoes, and sweet desserts.

A man subsisting on the ration as issued—that is, without changing proportions by rejecting some foods and taking proportionately

more of others—may escape damage to his bones and teeth if he holds a rating that requires him to spend most of his time on deck, so that he is abundantly exposed to sunlight. But if the results of feeding rats with deficient and unbalanced diets are significant, as they doubtless are, the probability of suffering damage is really very great for men in the engineer's force, yeomen, storeroom keepers, and men in certain other ratings who may, and sometimes do, go for considerable periods of time without spending more than a few minutes on deck each day in daylight hours. Such men, if they have subsisted for any great length of time on rations like those analyzed, must be regarded as being dangerously near bone or tooth damage. The man who with relatively little exposure to sunlight subjects himself to an even greater deficiency of calcium than would result with a balance such as indicated by calculating the average amount issued, and who thus, by unwise selection of foods from among those placed before him, still further changes the ratio between calcium and phosphorus, is certain, it would appear, to suffer damage in a comparatively short time, in months rather than years.

While a proper or optimum ratio between calcium and phosphorus may not be arithmetically stated, it is worth while to note the relationship between these elements in the more important foods, and particularly in foods which by virtue of supply and demand, habits of eating, etc., are the principal sources of both elements. It will be noted by reference to the table presented below, that in milk, and in the leafy vegetables, such as spinach, cabbage, lettuce, celery, etc., which are described as protective foods, the content of calcium is equal to or greater than the content of phosphorus.

With a well-balanced home dietary in which a pint of milk or more per capita per day is used, and leafy vegetables, stalks, and flowers, such as cauliflower, appear on the table daily in liberal amounts, there will generally be a calcium-phosphorus ratio of from 1:1.5 to 1:2. For the battleships the average ratio was about 1:3 in the foods as issued.

The following table shows the comparative value of various foods as issued on board ship with regard to the amounts of calcium and phosphorus furnished by equal weights of edible portion. The ratio between calcium and phosphorus is also given for each of the foods listed. The values are those given by Sherman, "Chemistry of Food and Nutrition," 1918 edition.

Calcium and phosphorus in grams per 100 grams of edible portion in various foods

Article	Calcium	Phosphorus	Ratio calcium to phosphorus	Article	Calcium	Phosphorus	Ratio calcium to phosphorus
Squash	0.019	0.000	1 to 0.0	Pumpkin	.023	.059	1 to 2.6
Olives	.122	.014	1 to .1	Eggs	.067	.180	1 to 2.7
Maple sirup	.107	.013	1 to .1	Beans, navy, dried	.160	.471	1 to 3.0
Watermelon	.011	.003	1 to .3	Oysters	.052	.155	1 to 3.0
Clams	.106	.046	1 to .4	Flour, wheat	.020	.060	1 to 3.0
Oranges	.045	.021	1 to .5	Bananas	.009	.031	1 to 3.4
Tangerines	.032	.015	1 to .5	Bread, wheat	.027	.093	1 to 3.4
Celery, trimmed	.078	.037	1 to .5	Beans, kidney	.132	.475	1 to 3.6
Cauliflower	.123	.061	1 to .5	Tapioca	.023	.090	1 to 3.9
Lemons	.036	.022	1 to .6	Potatoes, Irish	.014	.058	1 to 4.1
Sauerkraut	.045	.029	1 to .6	Peppers, green	.006	.026	1 to 4.3
Cabbage	.045	.029	1 to .6	Ice cream	.034	.154	1 to 4.5
Turnips	.064	.046	1 to .7	Peas	.028	.127	1 to 4.5
Cranberries	.018	.013	1 to .7	Crackers, soda	.022	.102	1 to 4.6
Cheese	.931	.683	1 to .7	Beans, lima, dried	.071	.338	1 to 4.8
Jam	.115	.087	1 to .8	Oats, rolled	.069	.392	1 to 5.7
Milk, evaporated	.300	.235	1 to .8	Cocoa	.112	.709	1 to 6.3
Vinegar, cider	.016	.013	1 to .8	Macaroni	.022	.144	1 to 6.5
Carrots	.056	.046	1 to .8	Codfish	.030	.313	1 to 10.4
Casaba melon	.007	.006	1 to .9	Corn meal	.018	.190	1 to 10.6
Cantaloupe	.017	.015	1 to .9	Fish	.014	.148	1 to 10.6
Grapefruit	.021	.020	1 to 1.0	Sardines	.026	.276	1 to 10.6
Lettuce	.043	.042	1 to 1.0	Rice	.009	.096	1 to 10.6
Spinach	.067	.068	1 to 1.0	Salmon	.021	.224	1 to 10.7
Butter	.015	.017	1 to 1.1	Hominy grits	.011	.144	1 to 13.1
Beans, string	.046	.052	1 to 1.1	Mincemeat	.008	.130	1 to 16.3
Onions	.034	.045	1 to 1.3	Corn, sweet	.006	.103	1 to 17.2
Beets	.029	.039	1 to 1.3	Beef	.009	.158	1 to 17.6
Radishes	.021	.029	1 to 1.4	Veal	.009	.163	1 to 18.1
Cake	.129	.185	1 to 1.4	Beef liver	.012	.218	1 to 18.2
Apple sauce	.006	.009	1 to 1.5	Pork	.008	.149	1 to 18.6
Peaches	.016	.024	1 to 1.5	Turkey	.009	.169	1 to 18.8
Pineapples	.018	.028	1 to 1.6	Fowl	.008	.151	1 to 18.9
Apple butter	.019	.031	1 to 1.6	Corned beef, fresh	.008	.151	1 to 18.9
Apples	.007	.012	1 to 1.7	Beef, chipped	.022	.416	1 to 18.9
Pears	.015	.026	1 to 1.7	Luncheon meat	.015	.285	1 to 19.0
Apricots	.014	.025	1 to 1.8	Sausage, Vienna	.010	.192	1 to 19.2
Mixed nuts	.086	.159	1 to 1.8	Frankfurters	.011	.212	1 to 19.3
Prunes	.016	.032	1 to 2.0	Sausage, bologna	.010	.194	1 to 19.4
Raisins	.064	.132	1 to 2.1	Bacon, sugar-cured	.005	.097	1 to 19.4
Cucumbers	.016	.033	1 to 2.1	Sausage, pork	.007	.137	1 to 19.6
Pickles	.022	.046	1 to 2.1	Ham, sugar-cured	.008	.157	1 to 19.6
Catsup, tomato	.119	.257	1 to 2.2	Corned beef, tinned	.014	.275	1 to 19.6
Tomatoes	.011	.026	1 to 2.4	Bacon, tinned	.005	.101	1 to 20.2
Potatoes, sweet	.019	.045	1 to 2.4				

Changes in Administrative Methods Necessary for the Prevention and Correction of Dietary Deficiencies in General Messes of the Navy

The evidence afforded by study of these battleship rations clearly indicates that their crews had plenty of food, a variety of proteins, including enough meat, eggs, and milk to furnish all essential amino acids in ample amounts for growth and repair of tissues and rather more of total nutrients than were required to support energy. If the food was reasonably well cooked and properly served and if no unusual quantities of foods were wasted, the men must, in general, have considered themselves well fed. However, the analytical findings show that the rations did not fulfill the requirements of good hygiene in several important details. Medical officers and supply officers should note that the defects do not depend upon defects in the ration law or to any great extent upon the policy of the Bureau

of Supplies and Accounts or instructions issued by that bureau. In fact, on the basis of this analysis, the only existing departmental instruction that seems open to criticism is that which reads, "Of the total quantities ordered under contract or procured by open purchase during any one month, or in any port when fitting out for sea, at least 70 per cent of all fresh vegetables shall be Irish potatoes, * * *."

The returns of the three battleships show that Irish potatoes constituted 66.25 per cent of the fresh vegetables issued. It is understood that "foods issued" in these returns represented foods actually prepared for meals and that the weights given included no food surveyed and condemned before issue as unfit for human consumption. This may be the reason why the percentage was less than 70. On the other hand, it may be that supply officers generally realize the required proportion is too great, as indeed it is, and that in practice there is a general tendency to reduce the percentage a little.

The 70 per cent requirement has been in force for many years. The proportion was possibly based chiefly on considerations that were not primarily of hygienic concern, such as availability, keeping qualities, ease of stowing, handling, and transporting, and upon the fact that a high proportionate amount of potatoes would tend to keep the cost of the ration low, but the requirement may also have been based in part upon the old conception that so long as proper relations existed between proteins, fats, and carbohydrates, with a variety of foods represented, the diet would necessarily be well balanced. Vitamins could hardly have been thought of, and probably it was not fully appreciated that the ration on board ship might often be deficient in calcium.

The objection raised here is not directed primarily against the potato as an article of diet or in fact against issuing potatoes to the extent of more than 1 pound per man per day. The objectionable feature is that the quantities of other fresh vegetables and especially those having good mineral contents and other protective qualities are made contingent upon the quantity of Irish potatoes purchased.

So far as the potato is concerned the utilizable fuel value is about 303 calories per pound, as purchased, or 380 calories per pound of edible portion. Protein matter amounts to about 2.2 per cent and carbohydrate 18.4 per cent. The water content is 78.3 per cent. Ash constitutes 1 per cent, but the calcium content is only 0.016 gram per 100 calories. The potato is a very useful source of starch and the ash is base forming. Theoretically, at least, it is a valuable article to balance acid-forming foods, such as meats and white bread. So, of course, are the vegetables and fruits in

general valuable. But the basic element in the potato is principally potassium, and therefore even on this score the potato is not altogether free from objection, for the amount of potassium that should be taken in the diet is generally believed to be quite limited. If the potassium intake is increased the tissues seem to demand more sodium than would otherwise be required. A demand is created for more table salt and for some or many individuals an increase in the sodium chloride intake may be undesirable.

Carbonic, phosphoric, and sulphuric acids are continually being produced in metabolism. The latter is a strong mineral acid. While it is readily fixed by proteins, it is yielded when the protein is resolved by hydrolysis into its constituent amino acids and must be disposed of eventually by neutralization and excretion. The fruits and vegetables in general, and among them potatoes, furnish bases capable of effecting neutralization. As L. J. Henderson has written, "Neutrality is a definite, fundamental, and important characteristic of the organism." Foods in which acid-forming elements predominate increase the acidity of the urine, increase urinary ammonia, and lessen the power of the urine to dissolve uric acid, which, not being destroyed, must be excreted as such. Potatoes help to make the urine less acid and to increase its uric acid solvent power. However, potatoes contribute very little calcium. The diet is not likely to be deficient in sodium or potassium but diets very often are deficient in calcium.

McCollum has pointed out that tubers have, from the nutritional viewpoint, characteristics similar to those of cereal seeds. Tubers are very poor sources of certain essential dietary factors, including the more important mineral elements. When potatoes are peeled and then cooked nearly all of the inorganic constituents which are contained in a cellular layer lying just beneath the thin, paper-like skin are lost, and they are likewise lost when the potatoes are cooked in their jackets, if the skins are not eaten. When pared, and the parings discarded, the potato is changed in its dietary properties in much the same way as is the rice kernel during the polishing process. McCollum and others have shown that potato nitrogen falls even below the value for growth possessed by the proteins of the several individual cereal grains.

There is no reason why the crew should not be given all the potatoes they want to eat within proper limits, but there are good reasons from the viewpoint of nutritional science why the quantity of fresh vegetables other than potatoes should not depend upon the quantity of potatoes furnished.

In the rations analyzed the weight of potatoes as issued was equivalent to 1.1225 pounds per man per day. That is a fairly high

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daily average and more than a well-balanced diet would ordinarily include. The total weight of all foods issued averaged 5.47 pounds per man per day, representing 4,624 calories or probably between 3,400 and 3,700 as available for consumption. To be sure, potatoes can be included in a diet to this extent without unfavorably affecting the balance, because after all the fuel value of potatoes is not great. There is a limit, of course. For example, a pound of potatoes (edible portion) yielding about 375 calories in a moderately light diet having a total fuel value of 2,400 or 2,500 calories would leave comparatively little room for protective foods, such as butter, milk, eggs, cheese, and leafy vegetables, whereas in a diet having a total fuel value of 3,500 to 4,000 calories, a pound of potatoes, more or less, would have very little or no effect in displacing proteins of high biological value or in displacing vitamin and calcium containing foods. But when the percentage of other fresh vegetables depends upon the percentage of potatoes purchased, the situation is very different. The result in this case is that the leafy vegetables, bulbs, and roots will not be used along with potatoes to furnish a fair proportion of total calories, but instead, under the conditions existing in the naval service, wheat in the form of white bread and other cereal seed products, demineralized and devitaminized, along with muscle tissues of animals and poultry will very largely account for the remaining calories.

From the viewpoint of nutritional science, therefore, it is very undesirable that a ship be so restricted as to the weights of the more desirable vegetables that may be purchased and issued. As matters stand, 70 of every 100 pounds of fresh vegetables purchased must be Irish potatoes. Often some of the remaining 30 pounds will be sweet potatoes, which are tubers having the same characteristics, so, practically, more than 70 per cent of fresh vegetables will be potatoes. Assuming, as we well may after studying the battleship returns as analyzed, that the ration will be deficient in protective foods unless more than 30 of every 100 pounds are vegetables other than potatoes, it is clear that the only way of increasing the quantities of protective vegetables is to increase the quantity of potatoes also when purchasing. These must either rot or be eaten in greater quantities than necessary or advisable. There will either be an unnecessary economic loss through waste or else the men will not be getting a well-balanced ration. In view of the practical necessity of keeping the cost of the ration within reasonable limits it is not likely that any article will be purchased in excessive quantities merely for the sake of issuing additional amounts of other articles. While more leafy vegetables could be furnished if potatoes were purchased in greater amounts than should or could be used that will not be done, because the cost of overissue

would have to be offset by underissue of some other article or articles of the ration. Potatoes will be purchased only to the extent that the crew is expected to eat them, with due regard to their keeping qualities and facilities for keeping them with minimum loss from spoilage. Consequently, so long as the 70 per cent requirement stands, fresh vegetables will be purchased in comparatively small quantities, and these will be insufficient if the leafy vegetables must be depended upon largely to furnish protective elements in the diet. Of course, if milk and milk products could be used freely a relative or an absolute deficiency in the leafy vegetables would not matter so much, but it would still be important to furnish them more liberally than they are being issued at present according to the returns studied.

When a ship is fitting out for sea it is useless to stock up with fresh vegetables in greater quantities than can be used to good advantage before they spoil. However, the quantities carried should be as great as can be kept with due regard to climatic and weather conditions likely to be encountered. Some risk of spoilage is clearly justifiable from the standpoint of good hygiene. First and last a good many potatoes rot in naval vessels. Some of the other vegetables keep fairly well even if the risk is somewhat greater than with potatoes, notably carrots, turnips, beets, and cabbages. The last is especially valuable. Certainly when the capacity of cold-storage rooms or favorable weather conditions make it possible to stock up with adequate quantities of vegetables having protective qualities it is undesirable that there be any other limiting factor. It is especially undesirable that restrictions, depending upon the amount of potatoes purchased, be imposed on a naval station where markets are constantly available and risk of spoilage is not a factor, or upon a ship which is at a navy yard during the entire month, or for that matter upon a ship while in port for any length of time. Recognizing the probability that the ration will be deficient in calcium and possibly in other dietary factors for a part of the time at least, while separated from sources of supply, it should be possible to take advantage of every opportunity for feeding optimum quantities of leafy vegetables (and likewise of milk and milk products) when and while they are obtainable.

It might be a reasonable requirement for ships stocking up for a cruise that not less than 60 per cent of all fresh vegetables be Irish potatoes. Doubtless, some such instruction definitely indicating the proportion of potatoes to be purchased under such conditions is necessary for the guidance of supply officers. With potatoes constituting 66.25 per cent of fresh vegetables issued they furnished 13.66 per cent of total carbohydrates, while all other fresh vegetables furnished only 4.8 per cent. Bread and other wheat-flour products

accounted for 36.65 per cent of total carbohydrates; sugar, as sugar, for 22.14 per cent; and fresh fruits for 3.6 per cent. Irish potatoes represented 20.5 per cent of the total weight of all foods issued and accounted for 7.37 per cent of total calories available.

Nothing has been said of canned goods. The above remarks have been devoted to discussion of the effect of making the amount of other fresh vegetables purchased contingent upon the quantity of potatoes purchased. It is of course possible to plan a well-balanced diet without including any fresh milk or any fresh vegetables, and such a diet need not be deficient in any essential dietary factor known or not yet recognized. Vitamins for the most part remain active in canned goods if contained in the food when processed, and, of course, the mineral constituents of the different foods are retained. However, in handling the ration on board ship acceptability is an important factor, and, so long as a man prefers to subsist chiefly on meat, white bread and other cereal foods, potatoes, and sugar, his diet may be sadly deficient unless he can be persuaded to eat adequate amounts of such canned foods as will prevent deficiency. Most men will eat freely of canned tomatoes. This article alone is capable of furnishing abundant amounts of the fat soluble A, water soluble B, and the antiscorbutic vitamin. In quantities usually eaten, canned tomatoes are likely to furnish more fat soluble A than butter. Unfortunately tomatoes furnish relatively and actually little calcium and the ratio between calcium and phosphorus is rather strongly in favor of the latter.

Realizing that deficiency of the ship ration in calcium is principally due to conditions that can be corrected on board ship, medical officers and supply officers should see to it that as much use as possible is made of foods that are relatively rich in calcium. The tables given above indicate what those foods are.

Method of Calculating the Fuel Value of a Ration

The first step is to secure a list of the foods issued in a given period, showing the weight of each article used. Next, one turns to the Atwater and Bryant tables giving the chemical composition of American food materials. These tables are to be found in Bulletin No. 28, published by the United States Department of Agriculture. Bulletin 28 may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. The price is 10 cents. Every medical officer should have a copy for reference, even though he may never be called upon to analyze a ration.

The following examples selected at random indicate the manner in which the tables are constructed:

Food materials	Number of analyses	Refuse	Water	Protein: N by 6.25	Protein: By difference	Fat	Total carbohydrate	Ash	Fuel value per pound
BEEF, FRESH									
Hind quarter, medium fat:									
Edible portion—		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct*	*Calories*
Minimum	11	....	55.7	17.2	*15.9*	16.8	....	0.8	1,070
Maximum	11	....	63.9	19.5	*18.7*	26.6	....	1.0	1,430
Average	11	....	59.8	18.3	*17.7*	21.6	....	.9	1,250
As purchased—									
Minimum	11	13.8	44.4	13.7	*13.6*	14.3	....	.6	910
Maximum	11	20.2	54.3	16.5	*15.8*	22.6	....	.8	1,205
Average	11	15.7	50.4	15.4	*14.9*	18.3	....	.7	1,060
BEEF									
Loin steak, tenderloin, broiled, edible portion:									
Minimum	6	....	42.7	19.8	*20.6*	11.8	....	1.0	925
Maximum	6	....	64.5	26.7	*26.6*	35.7	....	1.4	1,875
Average	6	....	54.8	23.5	*23.6*	20.4	....	1.2	1,300
POTATOES, RAW OR FRESH									
Edible portion:									
Minimum	136	....	67.8	....	1.1	....	13.5	.5	285
Maximum	136	....	84.0	....	3.0	.2	27.4	1.9	570
Average	136	....	78.3	....	2.2	.1	18.4	1.0	385
As purchased	....	20.0	62.6	....	1.8	.1	14.7	.8	310
TOMATOES, CANNED, AS PURCHASED									
Minimum	19	....	92.5	....	.3	.1	1.4	.2	80
Maximum	19	....	97.9	....	1.7	.3	8.1	1.2	135
Average	19	....	94.0	....	1.2	.2	4.0	.6	105
BEANS, DRIED, AS PURCHASED									
Minimum	11	....	9.6	....	19.9	1.4	57.2	2.7	1,540
Maximum	11	....	15.5	....	26.6	3.1	63.5	4.4	1,690
Average	11	....	12.6	....	22.5	1.8	59.6	3.5	1,605
White bread, all analyses, as purchased, average [1]	198	....	35.3	....	9.2	1.3	53.1	1.1	1,215

[1] Analyses of similar bread made from different grades of flour, from high to low grade.

The values for almost all articles can be found in the tables, but a little ingenuity will be required to estimate the chemical composition of a few things not listed, such as ice cream, mixed nuts, cakes of different kinds, casaba melon, and some of the canned soups. The chemical composition of ice cream will obviously depend upon the percentages of cream or butter fat and of other ingredients used in making it. The values assigned for mixed nuts will depend upon the mixture. The chemical composition of casaba melon is not shown in the table. Inasmuch as this article will not furnish any considerable proportion of total calories in the diet, or even of inorganic constituents, the estimation will be close enough if it is considered to have the same chemical composition as cantaloupe which is represented in the table.

In selecting percentage figures from the table, care should be used to pick values which most nearly represent the particular article in the ration. For example, if the ration list includes beef, hindquarter, the average percentages for beef, hindquarter, as purchased,

should be taken. It will be noted that of every hundred pounds of hindquarter as purchased there are 15.7 pounds of refuse—bone, trimmings, etc.—and 15.4 pounds of protein; whereas, of the edible portion, protein constitutes 18.3 per cent. If, while in port, sirloin steak, cuts for roasting, etc., were purchased as such, the values for the weights so purchased must be taken from the percentages given in the table for these cuts respectively.

The method of calculating food values is as follows: Let it be assumed that among the foods issued for 1,421 men during a month of 30 days, there were 12,449 pounds of bread.

According to Bulletin No. 28, for white bread, all analyses, as purchased, the average figures for nutrients are: Protein, 9.2 per cent; fat, 1.3 per cent; and carbohydrate, 53.1 per cent—$12{,}449\times0.092=1{,}145.308$ pounds of protein, $12{,}449\times0.013=161.837$ pounds of fat, and $12{,}449\times0.531=6{,}610.419$ pounds of carbohydrates.

The values for each and every article issued are to be calculated in the same way. They may then be listed as follows.

Article	Pounds protein	Pounds fat	Pounds carbohydrate
Bread	1,145.308	161.837	6,610.419
Potatoes, etc			
Total			

The totals, it will be remembered, are for 1,421 men for 30 days, or for $30\times1{,}421=42{,}630$ man-day rations. Therefore, the total number of pounds of protein divided by 42,630=the weight of protein issued per man per day. There are 453.592 grams to 1 pound. If the weight is first calculated in terms of pounds for one man per day, 454 grams represents a pound closely enough for practical purposes, but if the weights are to be converted into grams before reducing to the per capita per day amounts the more exact equivalent for a pound, 453.592 grams, should be used.

The number of grams of protein per man per day having been calculated, the number of grams of fat and of carbohydrate are calculated in the same way.

The heat-unit factors to be used are:

	Calories per gram
Protein	4
Fat	9
Carbohydrate	4

The unit is the large calorie. It is the quantity of heat required to raise the temperature of 1 liter of water one degree centigrade.

The factors used in calculating the fuel values per pound of different foods in the Atwater and Bryant tables (Bulletin No. 28)

were Rubner's factors—protein, 4.1 calories; fat, 9.3 calories; carbohydrate, 4.1 calories per gram. The smaller figures are now almost universally used as better representing average utilizable fuel values.

Protein calories, fat calories, and carbohydrate calories per man per day having been separately calculated, these are added together to show the total fuel value of the ration per man per day as issued.

The nutritive ratio may be determined by dividing fat calories plus carbohydrate calories by protein calories. This is the simplest way of calculating this ratio, which is of more limited value as an index of the balance of a ration or diet than it was considered to be a few years ago.

Gatewood, following Atwater's work, defined the nutritive ratio of a diet as the ratio between the amount of digestible protein, on one hand, and the amount of digestible fats and carbohydrates, on the other, these being considered as fuel constituents of the food in contradistinction to protein, regarded as tissue-building material. In calculating the ratio, each gram of fat is considered as equivalent in fuel value to 2.25 grams of carbohydrate. Therefore, the ratio is calculated by multiplying grams of fat by 2.25, adding the number of grams of carbohydrate, and dividing by the number of grams of protein in the diet. The ratio is obviously the same whether calculated from utilizable calories or from grams of nutrients in the manner described.

In studying a ration, among other things it is important to know the weight of protein in grams per man per day, the percentages of this amount furnished by the various foods used, the total fuel value of the ration or diet, and the percentage of total calories represented by protein calories. Grams of fat and grams of carbohydrate per man per day should also be shown in the summary. In making a complete analysis of a ration it is convenient to draw up a table showing for each food listed the average amount issued per man per day in grams and also protein, fat, and carbohydrate calories utilizable from this amount.

If it be desired to calculate the amount of any of the essential inorganic constituents available in the foods as issued—calcium, magnesium, potassium, sodium, chlorine, sulphur, iron—a work on the chemistry of foods will be required. The tables in Sherman's book, "Chemistry of Food and Nutrition," present the necessary information, conveniently arranged. The weight of each mineral constituent in grams per 100 grams of each of the commonly used foods is given in one table and the weight in grams per 100 calories of fuel value is shown in another table for the same foods. The values for calcium and for phosphorus in foods likely to be issued

in Navy general messes are given in the tables presented above in this article.

We may now consider the question, What are the essential features of a well-balanced diet? The answer involves discussion of tissue needs for growth and repair and energy requirements, depending upon the age and size of the individual and upon varying conditions of work or exercise, under different climatic influences.

(To be continued)

AN OUTBREAK OF FOOD POISONING (BACTERIAL TOXIN) AT THE UNITED STATES SUBMARINE BASE, PEARL HARBOR, T. H., ATTRIBUTED TO POTATO SALAD

Three men had moderately severe symtoms and some 35 or 40 other mean were slightly affected at the same time.

The suspected food was potato salad, served at the evening meal, July 12, 1925. The potatoes had been boiled in their skins during the morning watch. They were peeled and sliced while still warm and then placed in a large container where they stood until the middle of the afternoon when the salad was prepared. It was served at 5.30 p. m.

Cold sliced meats were served at the same meal, and conclusive evidence was not obtained to prove that the potato salad was responsible for the poisoning, but it was considered by the medical officer to be the most likely cause.

About 600 men ate the evening meal. Many of those who were not affected stated they had not eaten any part of the salad. While the medical officer did not directly state that all who had symptoms had eaten of the salad the inference drawn from his report is that they did.

First indications of illness appeared about three and one-half hours after the salad was eaten. The symptoms were those usually observed in such outbreaks—frontal headache, vomiting, pallor, spasmodic pains in the abdomen, and, later, slight cyanosis and moderate prostration.

Symptoms lasted but a few hours in most cases, but the three men who were most severely affected were sick five days. Presumably they were infected, whereas the majority, who had mild symptoms, escaped bacterial invasion. It is probable that very little toxin was produced during the few hours that the food was exposed to bacterial growth.

Stools and urines were cultured at the United States Naval Hospital, Pearl Harbor, for bacilli of the food poisoning group, but the results were negative. No part of the suspected food was obtainable for examination.

The report was submitted by Lieut. W. M. Peberdy, Medical Corps, United States Navy.

FOUR CASES OF FOOD POISONING IN THE WARDROOM MESS, U. S. S. "WYOMING," ATTRIBUTED TO COLD SLICED MEAT, PRESUMABLY BOLOGNA SAUSAGE

The suspected food was bologna sausage. Sliced meats, bologna sausage, ham, and beef were served cold for luncheon, July 9, 1925. Three officers were mildly affected and one had rather severe symptoms for about 48 hours. All four who had symptoms had eaten bologna; three of the four had eaten some of the beef also. Two of them had not eaten any of the ham. About 25 other officers, who had no manifestations of poisoning, ate of the suspected food.

The bologna sausage was the first to be used from a case which had been drawn from the commissary department's cold-storage room about three weeks before and transferred to the officers' cold-storage compartment.

The portion used had been kept in the refrigerator in the wardroom pantry for two days. The ship was at Panama, and the weather was quite hot.

The officer who was most severely affected became nauseated rather suddenly about six hours after luncheon. He vomited and was presently seized with spasmodic abdominal cramps. A few hours later profuse watery diarrhea began. This lasted for about 48 hours, with six to eight stools per day. Shortly after the onset of symptoms the patient's temperature was 101° F. The following morning the temperature was normal.

It was not practicable to make bacteriological or toxicological examinations.

The report was submitted by Lieut. Commander W. W. Hargrave, Medical Corps, United States Navy.

APPARENT IDIOSYNCRASY FOR LOBSTER PROTEINS—AN UNSATISFACTORY REPORT OF A CASE SO REGARDED

Lobsters recently caught, and brought on board the U. S. S. *Pittsburgh* while alive, were consumed within 24 hours after delivery. Thirty or forty persons in all ate of the lobsters. Only one man was affected, a wardroom mess attendant. About two hours after eating the lobster meat and lobster eggs he suffered nausea and discomfort in the epigastrium. He soon became very ill and showed symptoms of collapse. Later a general red macular eruption developed.

The question, how should the case be charged from the statistical standpoint, is a difficult one to answer. The medical officer in submitting his report failed to state whether the lobsters were boiled promptly and thoroughly after they were received. The statement

that they were alive is a general one. It was not explicitly stated that they were examined with sufficient care by the wardroom steward or by any one else to ascertain that all were alive when they were cooked. It was not stated whether a salad was made or whether they were served individually. If they were served individually, it is not known whether the patient ate a whole lobster, half a lobster, or halves from different lobsters.

The report states: "Consideration of all circumstances convinced the medical officer that it was a case of mutual incompatibility between the patient and the lobster." However, that kind of *ex cathedra dictum* is not convincing to the reviewer. A conflicting statement is that the patient possibly consumed food and drink while on liberty ashore.

The medical officer concluded with the statement: "Nothing was to be gained by culture of feces, animal experimentation and other research procedures, even had facilities for such been available." He is wrong about that. Making cultures from the patient's feces and urine is not a research procedure; it is an ordinary activity of the diagnostic laboratory. One never knows in such cases whether a culture will reveal the presence of a bacillus belonging to the meat poisoning group. The symptoms in this case may have been the result of an idiosyncrasy. A statement might have been made regarding previous indications of sensitization to lobster meat, other kinds of shell fish, or food of any kind. It is true that facilities for making cultures were not available in this case, but it must have been possible to ascertain whether the lobsters were properly cared for and cooked.

CONVEYANCE OF INFECTIONS BY CERTAIN FOODS

The following, an excerpt from a paper read by Dr. Louis I. Harris, Commissioner of Health, City of New York, at the fifty-first annual meeting of the New Jersey Sanitary Association, is taken from the Weekly Bulletin, January 9, 1926, published by the Department of Health, City of New York:

"Because the tendency nowadays is to intensify efforts in the prevention of communicable disease by means of specific immunizing injections, it is well to emphasize that we can not afford to neglect the supervision of methods of food-handling and distribution that may introduce massive doses or virulent strains of disease-breeding organisms. The subject is large. I, therefore, wish to call attention to but one aspect of it.

"Thanks to the pioneer efforts of Mr. Nathan Straus, Pasteurization of milk has come to be adopted in every large community of this and other countries, as an established and necessary measure to

reduce infant mortality. It needs somewhat of the same zeal and unceasing effort to secure an equally wide Pasteurization of butter and other milk products.

"While Pasteurization destroys the bovine tubercle bacillus and thus eliminates one fertile source of bone, joint and gland tuberculosis, the subsequent methods of handling of the Pasteurized product are frequently ignored. This may frequently lead to the contamination of milk or butter by dust and by the process of handling and thus reintroduce a variety of organisms which may breed and spread disease. No epidemiological data are available, as far as I have been able to ascertain, as to the frequency with which the improper handling of dairy products may figure as a causative factor in spreading communicable disease. But one may assert with almost axiomatic force that public health officials should unhesitatingly prevent conditions which are potentially dangerous, even when there is no statistical evidence that they have actually wrought damage. Observations as to the manner of handling milk and butter in retail stores, restaurants, and the myriad of food-serving soda counters springing up everywhere about us would tend to show that they constitute another potential and substantial source of danger. The suggestion is here ventured that the maintenance of the degree of bacteriological purity effected by Pasteurization, by the subsequent handling and distributing of milk and milk products is an effort worth while in relation to the prevention of communicable disease.

"The inevitably hurried and unsatisfactory methods of washing soda-water glasses and spoons in the course of the noonday or after-theater rush hours are definitely potential sources for the spread of respiratory infections. At the season of the year when influenza and pneumonia loom large, this matter becomes of fairly serious import. It would be interesting to pursue epidemiologic studies to ascertain whether pneumonia is more prevalent and more serious as a complication of the infectious diseases of childhood, when it is very prevalent as a primary disease in adults. And if so, to what extent is the virulence of pneumonia enhanced by the insanitary soda fountain or restaurant?

FOUR HUNDRED THOUSAND POUNDS FOR VENEREAL-DISEASE CONTROL IN GREAT BRITAIN

The following is taken from Health News, issued by the United States Public Health Service. We added italics.

"That the British Government is fully alive to the gravity of the problem of the venereal diseases and to the importance of doing everything possible for the improvement of the public health in

this respect was made clear by the Right Hon. L. S. Amery, Secretary of State for the Colonies, in the opening address of the Imperial Social Hygiene Congress, recently convened under the presidency of Sir Auckland Geddes. The ancient policy of hushing up the evil, said the secretary, could only give dangerous results, but happily that point of view has entirely vanished. In 1911, it was practically impossible to get a single member of Parliament to say a word about these diseases. When in that year Lloyd-George, as a young member, pleaded for a recognition of these diseases, he felt almost an outcast. The changed outlook is indicated by the fact that in 1924 nearly £400,000 was spent by the Government in improving the health of the country through venereal-disease control measures. The situation, according to Mr. Amery, is distinctly hopeful, because, from the medical point of view, there is no range of disease so definitely capable of being dealt with and cured if public opinion is only strong enough. This weakness of public opinion, reflected in ignorance, indifference, and fatalism, has been the great difficulty in the past. *He concluded his address with the observation that by treating these diseases quite frankly as diseases, by making medical care easy and natural, and by removing all question of stigma, he believed that a solution of the problem could be arrived at.*

"The British Navy lost 325,557 days in the year from venereal diseases, according to a statement made by Surg. Commander T. B. Shaw in a recent address before the Imperial Social Hygiene Congress. In commenting upon the relationship between venereal disease and prostitution, Commander Shaw stated that the abolition of brothels must in the end lead to a material reduction in venereal disease. He pointed out that in Gibraltar the marked decrease in the venereal disease incidence, particularly that of gonorrhea, coincided with the closing of the local brothels and the refusing to renew permits of residence to prostitutes. Healthy recreation, he insisted, was the enemy of the vice with which they were concerned and that everything possible should be done to insure that seamen on leave would have facilities to indulge in healthy pursuits."

OBSERVATIONS RELATING TO VENEREAL DISEASES AND THEIR CONTROL IN THE STATE OF ILLINOIS

The following excerpts are taken from articles which appeared in Illinois Health News for November, 1925, the official monthly bulletin published by the State Department of Public Health.

In an editorial, Bernard C. Roloff, executive secretary of the Illinois Social Hygiene League and superintendent of one of the busiest venereal-disease clinics in Chicago, is quoted as saying:

"Five years ago 90 per cent of the men who came to our clinics were infected by prostitutes. To-day at least 60 per cent of the men who come to our clinics for treatment, on their own admission, charge that they were infected by 'girl friends.' Five years ago 90 per cent of the women who came to our clinics were married women over 22 years of age who admitted having been infected by their husbands. To-day the average age of first infection among women is 16 years, and the majority of them are single and admit having been infected by 'boy friends.' Of course the same number or even a larger number of married women infected by husbands are still coming for treatment, but the percentage of married women has been reduced by the large number of single girls of tender age who are appealing for medical aid because of their indiscretions."

The following statements were made in an article, "The prevention and control of venereal disease," by I. H. Neece, M. D., of Decatur, Ill., a physician specializing in the treatment of venereal diseases:

"* * * One thing the war did for us was to make us face fairly and squarely and consciously the whole situation. It did not reveal anything especially new except the prevalence of venereal diseases as we have never known it before. * * *

"The reason that the control of venereal diseases, and especially syphilis, looms on the horizon as an immediate necessity, is that the morbidity and gravity of this disease makes it a social danger of the same magnitude as cancer, tuberculosis, and alcoholism.

"Syphilitic infection not only attacks the person who contracts it but not infrequently his offspring suffers as the result of it. It decimates posterity and its losses in human life and in capital are incalculable. The slow but sure falling off of the race is in large part due to it. It is one of the most alarming scourges which oppresses the human race. * * *.

"The prophylaxis of syphilis is imposed as a duty which no one should evade. * * *.

"One of the principal, if not the only source of venereal-disease contamination is prostitution. By this I mean the broader definition, greater or lesser degree of promiscuity, even transient, in sexual relations, in exchange for remuneration or its equivalent. This definition includes all prostitutes without distinction of social class or trade.

"We are recognizing to-day as never before that an outstanding factor to be eliminated is sex delinquency which results in demoralization, and possibly in prostitution and disease. We know pretty well to-day what the results are of sex delinquency or promiscuous sex relations. It is because of them that we find our boys and girls in our children's courts as delinquents, possibly diseased. We find

innocent women and children diseased, blind, crippled, and insane—disabilities which have resulted from venereal disease infections.

"The appalling number of young girls who frequent our clinics to-day are not prostitutes in the 'old' meaning of the word, and they represent only the few who happen to come under the care of the city because they are diseased or because of some irregular sex relationship which brings them into the hands of the law. We know perfectly well how most of these are handicapped by bad heritage, poverty, desolation, and neglect. At this critical period in their lives they are seeking recreation. If we do not provide the right kind of recreation we know now that we have no right to expect to keep them away from commercialized recreations and all the temptations that will come in other forms to young people when they have not the outlet for wholesome fun and play. In view of these facts which only hint at the venereal problem, certain methods have been worked out which should aid in its solution, especially in the smaller cities.

"The first of these is prevention by treatment of the disease. * * *.

"The second is 'follow-up' measures. * * *.

"The third method is moral and educational prevention. * * *.

"Logically the place for sex education is in the home. The first step is to teach the mothers, for on them falls the brunt of giving the child the right start, but the almost universal tendency of parents to shirk or evade their duty in influencing the sex life of their children brings continually to the front the proposition that the public school should undertake the sex education of children.

"What is required now is popular education—education not in disease, but in health. Ignorance of sex matters does not constitute virtue. If it did, the base of virtue would be very frail. Compare the advantages of caution, sex education, and its inconveniences. The decision is easily made. Sex education aims at discipline of sex instinct. Whatever may be the psychic and sentimental phenomenon accompanying sex instinct, it is the result of civilization and culture, but one must not forget that sexual instinct is a natural requirement, and often imperious. * * *.

"Human nature is of a disconcerting complexity. While purely educational means exercise a favorable influence on some, how many there are who forget their teachings when the sexual instinct, the strongest, the most irresistible, makes itself felt!

"Permit me to quote the following passage from St. Paul, which shows the awakening of sex in a man of the best moral education:

"'But I see another law in my members, warring against the law of my mind, and bringing me into captivity to the law of

sin which is in my members; . * * * So then, with the mind, I myself serve the law of God; but with the flesh, the law of sin.'

"Let us consider man as he is, not as we would wish him to be. We should deal rather with the sexual instinct, the most desperate enemy of moral prophylactic, than with the effect, often uncertain, of this prophylactic. Let us recommend the latter every time the occasion is presented, but let us not fail to search unremittingly for the means of preventing venereal disease when the sin spoken of by St. Paul already shall have been committed."

APPARENT REDUCTION IN THE NUMBERS OF SEVERE REACTIONS FOLLOWING THE ADMINISTRATION OF NEOARSPHENAMINE IN THE NAVY

The following figures are of interest:

December, 1924:	
Number of doses neoarsphenamine administered	1,973
Number of severe reactions	9
Alarming reactions	3
December, 1925:	
Number of doses neoarsphenamine administered	3,867
Number of severe reactions	1
Alarming reactions	0

(The reaction reported as severe was a local reaction resulting from leakage from the vein at the site of introduction.)

NOTE RELATIVE TO NONSPECIFIC PROTEIN REACTIONS[1]

Seibert says:

"Ling attempts to study comparatively the influence of various nonspecific protein agents on the reactive temperature, * * * on the mobilization of peripheral blood leukocytes, * * * antibodies and enzymes. * * *

"It was shown in a series of articles in the American Journal of Physiology that distilled water, even if it has been sterilized, is capable of producing considerable fever when injected intravenously, and this is because the water had at some time been contaminated by bacteria carried to it by dust in the air or in some other way. * * * They themselves may be killed during sterilization, but a soluble product which they have produced during their lifetime and which filters through the Berkefeld candle is heat stable and remains in the sterile water. It is this product, so far unidentified but containing nitrogen, which is responsible for the fevers produced when the waters are injected. The only method so far outlined for removing the fever-producing material from water is by distillation.

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[1] From Archives of Internal Med., Nov. 15, 1925, p. 747.

"In connection with the study of protein fevers, it was shown that casein when prepared in such a manner as to eliminate bacterial contamination did not produce fever when injected into rabbits, whereas all caseins prepared in the usual manner did produce fever. Whether or not it is the protein of the bacteria contaminating the distilled waters that is responsible for the temperature reactions is still an open question, but the presence of nitrogen in the fever-producing waters has been demonstrated.

"Therefore, in view of these clearly established facts, one can not evaluate the nonspecific effect of such mixtures as horse serum, milk, peptone, vaccines, yeast, etc., and expect similar results with different preparations of the same substance. The results obtained may possibly be due to contaminating substances and not at all to the agent specified."

OUTBREAK OF POLIOMYELITIS IN CORTLAND, N. Y., TRACED TO MILK

The following acount of an outbreak of poliomyelitis, reported as the first outbreak definitely traced to milk, is taken from Health News, January 18, 1926, published by the New York State Department of Health:

"During the third week of December six cases of poliomyelitis developed in the city of Cortland which has a population of approximately 15,000. All of the cases found by Dr. A. C. Knapp, health officer, had consumed milk obtained from the same dealer. This dealer furnished milk regularly to the families in which four of the cases occurred, the fifth drank it three times daily at a restaurant. The sixth case was discovered to have consumed some of the milk at a gathering which he attended six days before the onset of his illness.

"Prior to this there had been three cases reported in Cortland during 1925, the onsets of the cases being given as October 7 in all three. Despite their almost synchronous onsets these three cases each took milk from a different source and it was not possible to discover anything else in common.

"On December 7, seven days before the onset of the first case of this apparently milk-borne series, a boy, 16 years old, who was working on the dairy farm where the milk concerned was produced, became sick with fever, headache, pain in the back, and some diarrhea. He vomited on December 11. He continued at work, milking from 8 to 10 of the 20 cows of this diary, though he noticed his hands were growing progressively weaker and that he had some pain and tenderness in his left arm. On December 11 he was definitely paralyzed in his entire upper left extremity and his right deltoid muscle, but succeeded in milking three cows with his right

hand before his condition was noticed. He was immediately taken to his home in the city of Cortland, where he was isolated and subsequently cared for. In addition to the symptoms mentioned he is said to have had slight retraction of the head but no resistance to anterior flexion of the spine. His fever was reported as high (over 104° F.) when seen by the physician on December 11. This boy, in addition to milking cows, carried the milk to the cooler, and also assisted in filling the cans from the cooler, thus having an opportunity to infect practically all of the milk produced on the farm.

"The onsets of the subsequent cases were December 14 (1), December 16 (2), December 18 (2), December 19 (1). Two of these subsequent cases died from bulbar involvement, one on the second and the other on the fourth day after onset. There were no other cases in the city until December 25 when three more cases developed—one in a child, age 7, who consumed the suspected milk at home; one in a boy, age 19, whose mother worked in a restaurant which bought 35 quarts of this milk daily; the third child has no history of contact with any of the other cases, did not consume the suspected milk, and is regarded as an extremely doubtful nonparalyzed case.

"An investigation at the dairy failed to discover any evidence of paralysis or illness among the animals except that 5 of the 20 cows reacted to the tuberculin test on December 14. About 215 quarts of unpasteurized milk were sold from this dairy to a dealer in Cortland whose total daily output was 240 quarts. The total daily supply for the city is approximately 5,700 quarts.

"The cases which varied in age from 15 months to 22 years were not located in the same section of the city and their social relations were extremely tenuous or nonexistent."

VITAL STATISTICS OF THE NAVY NOT TO INCLUDE ADMISSIONS FOR DISABILITY EXISTING PRIOR TO ENTRY INTO THE SERVICE

To the statistician collating Form F cards it appears that medical officers do not always distinguish as well as they might with available evidence between disability that existed before the individual entered the naval service and disability acquired after entry.

In order that the vital statistics of the Navy shall not include admissions to the sick list for cases in which the disability to be recorded existed before the individual entered the service, medical officers are required in such cases to record readmissions, "RA," in accordance with the instruction given in paragraph 5 of Bureau of Medicine and Surgery's Circular Letter, 348—1924.

The question whether to admit or readmit in a given case is purely of statistical import. In making his decision the medical

officer is not to be concerned with the question whether the patient should be admitted as with origin in line of duty or not in line of duty. That question is to be settled independently on its merits and in accordance with established precedents. This division is not concerned with the latter question but is concerned with promoting the completeness and accuracy of the vital statistics of the Navy.

GENERAL USE OF SCARLET FEVER TOXIN FOR ACTIVE IMMUNIZATION OF NAVAL PERSONNEL NOT AUTHORIZED

So many requests have recently been made by medical officers of the Navy for scarlet fever toxin with a view to actively immunizing naval personnel against the disease that pertinent comment seems to be required at this time. Some of the requests have been for large quantities that would involve the expenditure of hundreds of dollars. The commanding officer of the United States Naval Medical Supply Depot, after considering the probable cost of filling requisitions, has requested advice of the Bureau of Medicine and Surgery and definite instructions regarding the matter. He noted that at the present rate at which requests are being received a large percentage of the total appropriation for biologic products would be required for this product alone.

If there is reason, except under peculiar conditions and circumstances which will rarely be encountered, actively to immunize naval personnel against scarlet fever, there is more need and more reason for actively immunizing the personnel against diphtheria. The bureau does not regard the latter procedure as generally necessary, desirable, or practicable, and epidemiological experience in the Navy has shown that diphtheria is more likely to become endemic in an organization and is eradicated in most instances with more difficulty than scarlet fever.

It must be borne in mind that we are dealing with adults and adolescents and not with children. So far as the bureau can foresee, occasions making it advisable actively to immunize persons in the Navy against scarlet fever will be very infrequent. It does not consider the routine immunization of recruits at naval training stations necessary, although it is conceivable that, upon a rare occasion, there might be endemic prevalence resulting from epidemics outside the Navy when for a time it might be desirable to apply the Dick test for susceptibility and to immunize those giving positive skin tests. But during the World War scarlet fever was not so troublesome that such a measure would have been called for if available. Diphtheria was much more prevalent and troublesome, and yet it was not found entirely practicable to immunize recruits with toxin-antitoxin. That was done for a time at the United States

Naval Training Station, Great Lakes, Ill., but finally the practice was discontinued on the ground that it was unnecessary and undesirable. Vaccination with cowpox virus is necessary. Three doses of antityphoid vaccine are also necessary. It must be remembered that many recruits are hit pretty hard by one or another of these doses and neither diphtheria toxin-antitoxin mixture nor scarlet fever toxin should be added in the absence of well-established indications.

Certainly it is not advisable to authorize the purchase of scarlet-fever toxin for ships and naval stations in general. At present it seems inadvisable to authorize purchase except in some special case where the medical officer desires to undertake a study to determine in a limited group the percentage of the men positive to the Dick test and the percentage of positive skin tests changed to negative after administering five doses of toxin. Such studies should be encouraged but the medical officer should give assurance that he is prepared to make careful record of his observations with a view to publication in the NAVAL MEDICAL BULLETIN. The use of scarlet fever toxin for active immunization has not yet passed entirely out of the experimental stage. There is especially opportunity to contribute data for adolescents and persons in older age groups.

In the minds of some medical officers, judging from the information furnished by the Naval Medical Supply Depot, there is some confusion regarding the different products now on the market intended for use in connection with the prevention and with the treatment of scarlet fever. The following summary is therefore given:

WHAT IS TRUE FOR DIPHTHERIA OF	IS TRUE FOR SCARLET FEVER OF
Schick test toxin.	Dick test toxin.
Toxin-antitoxin for active immunization.	Toxin outfits for active immunization.
Antitoxin serum, concentrated, for treatment of the diphtheria patient.	Antitoxin serum, concentrated, or unconcentrated, for treatment of the scarlet-fever patient.

Scarlet-fever toxin for active immunization.—Different manufacturers have adopted different dosages and have exercised their own ingenuity regarding size and character of containers. The regulations recommended by the Hygenic Laboratory of the United States Public Health Service and promulgated by the Treasury Department of the United States to govern license to manufacture this product for interstate sale, do not permit the sale of any vial containing more than 40,000 skin test doses of toxin. Therefore, according to the Dick scheme not more than two men could be given their final immunizing dose of 20,000 skin test doses each, from any one vial. The usual plan is to furnish an outfit for the immunization of one

person, consisting of five ampules or vials, each containing the toxin for one of the series of five doses. For example, the Squibb Company's outfit consists of five ampules or vials. Each contains 1 c. c. of toxin mixture but they differ with respect to the actual amount of toxin contained. The dosages are as follows:

Skin-test doses of toxin

First dose	500
Second dose	1,500
Third dose	5,000
Fourth dose	15,000
Fifth dose	20,000
Total	42,000

The regulations do not prescribe limits for dosage, and we do not know, that is, we have not ascertained, how many skin-test doses the Parke, Davis Co.'s outfit provides, but it is lower than Squibb's. Possibly the total for all injections amounts to 10,000 skin-test doses. The Lederle units are also on a smaller dosage scale; possibly the total for all injections would amount to 20,000 skin-test doses. It is understood that certain requests have specified Squibb's product on the assumption that it is more potent. The higher dosage used by the Squibb Co. doesn't mean that their product is any better than that of other manufacturers in the sense that the toxin is of better quality. It simply means that if the larger dosage is desired for the immunization of a given personnel more vials of the Parke, Davis Co.'s product, for example, would be required unless the company were willing to furnish higher dosage units.

Another apparent confusion of ideas noted related to a recommendation that Dochez toxin be issued. There is no toxin known as Dochez toxin for active immunization. Dochez's method of immunizing horses is to inject agar subcutaneously in the neck of the animal and then to inject the streptococcus culture into the agar, whereas the Dicks inject their horses with toxin produced in broth cultures and freed from microorganisms. But, so far as we know, Dochez has confined his experimental work to the development of antitoxin and has not recommended a method of preparing toxin for active immunization of human beings or for skin tests. The Lilly Co. manufactures antitoxin (curative serum) by the Dochez method.

Scarlet fever antitoxin.—This product should be placed on the supply table of the medical department of the Navy. Its early use is indicated in the treatment of the patient ill with scarlet fever. The bureau does not approve of administering it to healthy persons with a view to immunizing them passively against the disease, except

under very unusual circumstances. Again be reminded that we are speaking of young adults; not of school children, and especially not of children of preschool age. Medical officers should bear in mind the cost of the serum and the maximum number of patients for which serum is likely to be needed before an additional supply can be obtained either by purchase ashore or from some other naval organization. Much valuable serum has spoiled in the Navy before occasion to use it has arisen. A naval hospital able to obtain scarlet-fever antitoxin within an hour from local dealers might well avoid carrying a single dose in stock. Three doses for emergency use will in almost all cases suffice for a cruising ship if future experience proves to be in accord with past experience. One or two doses per ship should be sufficient for ships which will always be either in company with other ships or at a navy yard. For the same reasons, comparatively small supplies of diphtheria antitoxin and antimeningococcus serum should be carried.

STATISTICS RELATIVE TO MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

The following tables were constructed with figures taken from monthly reports submitted by boards of review at naval training stations:

Cumulative data for January 1 to December 31, 1925

	Number	Per cent of recruits received	Per cent of recruits reviewed
All naval training stations:			
Recruits received during the month	9,385		
Recruits appearing before board of review	688	7.33	
Recruits recommended for inaptitude discharge	465	4.95	67.59
OCTOBER, NOVEMBER, DECEMBER, 1925			
U. S. Naval Training Station, Hampton Roads, Va.:			
Recruits received during the month	446		
Recruits appearing before board of review	31	6.95	
Recruits recommended for inaptitude discharge	30	6.73	96.77
U. S. Naval Training Station, Great Lakes, Ill.:			
Recruits received during the month	660		
Recruits appearing before board of review	41	6.21	
Recruits recommended for inaptitude discharge	25	3.79	60.98
U. S. Naval Training Station, San Diego, Calif.:			
Recruits received during the month	917		
Recruits appearing before board of review	118	12.87	
Recruits recommended for inaptitude discharge	33	3.60	27.97
U. S. Naval Training Station, Newport, R. I.:			
Recruits received during the month	787		
Recruits appearing before board of review	69	8.77	
Recruits recommended for inaptitude discharge	53	6.73	76.81

ADMISSIONS FOR INJURIES AND POISONING, FOURTH QUARTER, 1925

The following table indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during the fourth quarter, 1925, is based upon all Form F cards covering admissions in those months which have reached the bureau:

	Admissions, October, November, and December, 1925	Admission rate per 100,000 per annum	Admission rate per 100,000, year 1924
INJURIES			
Connected with work or drill	870	3,109	3,148
Occurring within command but not associated with work	685	2,448	1,705
Incurred on leave or liberty or while absent without leave	376	1,344	1,004
All injuries	1,931	6,901	5,857
POISONING			
Industrial poisoning	15	54	21
Occurring within command but not connected with work	16	57	128
Associated with leave, liberty, or absence without leave	7	25	126
Poisoning, all forms	38	136	175
Total injuries and poisoning	1,969	7,037	6,032

Percentage relationships

	Occurring within command				Occurring outside command	
	Connected with the performance of work, drill, etc.		Not connected with work or prescribed duty		Leave, liberty, or a. w. o. l.	
	October, November, and December, 1925	Year, 1924	October, November, and December, 1925	Year, 1924	October, November, and December, 1925	Year, 1924
Per cent of all injuries	45.0	53.7	35.5	29.1	19.5	17.2
Per cent of poisonings	39.5	12.1	42.1	73.4	18.4	14.5
Per cent of total admissions, injury and posioning titles	44.9	52.5	35.6	30.4	19.5	17.1

Poisoning by a narcotic drug or by ethyl alcohol is recorded under the title "Drug addiction," or "Alcoholism," as the case may be. Such cases are not included in the above figures.

The following cases, selected from October, November, and December, 1925, reports, are worthy of notice from the standpoint of accident prevention:

Hatch cover improperly secured.—The cover was held open by a hook which was attached to a line suspended from above. Motion of the ship caused the hook to work loose. The cover fell on a man who was passing through the hatchway. Result: Lacerated wound of the face. Four sick days.

Hatch cover not secured with safety line as required.—While descending a ladder to a storeroom a man placed his hand on the hatch-cover chain. The hatch cover was not secured with a safety line as it should have been; a slight pull drew it out of balance and it fell on the man's hand. Result: Crush of fingers. One hundred and fifty-two sick days.

Hatch cover improperly secured.—The cover fell on a man and caused lacerated wounds of the nose and face. The accident was attributed to lack of a safety device.

Hatch cover improperly secured.—The cover fell on a man's hand. Result: Compound fracture. One hundred and eighteen sick days; invalided from the service.

Hatch cover open and not secured.—A man in making his way to a storeroom lifted the cover of a hatch and neglected to place the pin in support to insure that the hatch cover would remain upright. The cover fell. Result: Lacerated wound of the scalp. Five sick days.

Open hatch unguarded.—A man fell through a hatch which was left open and unguarded during general quarters. Result: Contusion, sacrum. Two sick days.

Manhole cover elevated and improperly secured.—A hook which was used to hold the cover up was improperly shaped. It slipped off and the cover fell on a man's hand. Result: Contused wound. Four sick days.

Inadequate illumination.—A man struck his foot against a stanchion in a dark passageway while the standing light was out. Result: Fracture, foot. Twelve sick days.

Inadequate illumination.—A man struck his foot against some object in a dark passageway while the standing light was out. Result: Fracture, toe. Ten sick days.

Inadequate illumination.—A man in passing through a dark compartment fell over a pile of mess benches. Result: Contusion of ribs. Five sick days.

Planer; lack of safety device.—Injury: Avulsion of two fingers. Thirty-two sick days. The injury was attributed to lack of safety device.

Planing-machine accident; lack of experience in handling.—Tip of finger cut off. Twenty-five sick days.

Power saw; carelessness; lack of safety device.—While the saw was in motion a man reached across it for a piece of wood. Result: Lacerated wound, thumb. Ten sick days.

Circular saw; carelessness; lack of safety device.—The operator's foot slipped and his hand came in contact with the saw. Result: Avulsion of finger. Twenty-four sick days.

Circular saw; unsafe practice; attempting to clean while in motion.—Injury: Lacerated wound of two fingers. Five sick days.

Joiner; unsafe practice.—A man wore gloves while working a joiner. A glove caught in the machine. Result: Amputation, finger. Three sick days.

Electric blower; unsafe practice.—While attempting to clear a defective wire protective screen from the blades of an electric blower while it was in motion a man caught his hand in the blower. Result: Lacerated wounds, two fingers. Eight sick days.

Unsafe practice; failure to wear goggles provided for lathe work.—Hot particles caused a burn of the eye. Four sick days.

Unsafe practice; Christmas tree conflagration.—A man was acting as Santa Claus at a Christmas celebration. His robe caught fire from lighted candles. Result: Burns of both hands. Nine sick days.

Food-grinder accident; careless handling.—A man tried to remove a piece of meat from the machine while it was in motion. Result: Lacerated wound, finger. Nineteen sick days.

Food-grinder accident; carelessness.—A man put his hand in the meat grinder while it was in motion. Result: Avulsion of two fingers. Forty-one sick days.

Bread-slicer accident; carelessness.—A man while slicing bread looked around to talk to a shipmate. Result: The tips of two fingers were sliced off. Eleven sick days.

Anchor windlass; defective brake bands.—The bitter end of the anchor chain ran out, striking a man on the hand. Result: Fracture, hand. Eighty-four sick days. The accident was attributed to the fact that the brake bands on the windlass were too loose.

Defective line on staging.—A line supporting a staging over the side of the ship parted. The ship was in dry dock. A man was thrown from the staging and was killed.

Ash hoist; defective line.—A faulty line parted while ashes were being hoisted from the fireroom. A bucket of ashes fell on a man's hand. Result: Compound fractures, two fingers. Sixty-eight sick days.

Coaling ship accident; carelessly given signal.—The signal to hoist bags of coal was given before the "hookman" was ready. The latter's finger was caught in the hook and he was hoisted with the coal. A crushing wound of the finger resulted. Eleven sick days.

Automobile accident; car cranked while in gear.—The man who cranked the car was knocked down. Result: Fracture of lumbar vertebra. Forty-one sick days.

Motion-picture film, ignition of.—A motion-picture machine operator removed a fuse, and while it was hot dropped it on an exposed film. A fire was thus started, which caused severe burns of the

arm of a man who was sleeping near by on the deck of the compartment. Fourteen sick days.

Cresol, careless handling of.—Cresol had been spilled on a washroom deck on board ship and left there. Two men with bare feet stepped in it. Result: Chemical burns. Eight sick days for each man.

Gasoline, careless handling of.—A man while preparing to burn some rubbish at a naval air station spilled gasoline on his trousers. When he started the fire the flames ignited his trousers. Result: Severe burns, both legs. Thirty-six sick days.

Gasoline, careless handling of.—A man cleaning up after work was washing his arms in a bucket of gasoline. Another man, passing by, dropped a lighted match in the bucket. Result: Severe burns, both arms. Eight sick days.

Gasoline, careless handling of.—A man was washing his hands in gasoline after painting. He used an unlighted match to clean his nails. The match ignited. Result: Multiple burns. Forty-five sick days.

Gasoline, careless handling of.—After flaming a bunk with a blow torch a man applied gasoline to the bunk while the torch was near by. The gasoline vapor exploded. Result: Severe burns of the face and hands. Sixteen sick days.

Gasoline, lack of caution in using.—A man was cleaning oil burners in a bucket of gasoline. Another man started an electric motor at a bench near by. A spark ignited the gasoline. Result: Severe burns of both arms. Eight sick days.

Gasoline, gross carelessness in handling.—An apprentice seaman while filling the gasoline tank of a motor sailer lit a match to see how full it was. An explosion followed. Result: Burns of the arms. Three sick days.

Kerosene, careless handling of.—A man while lighting off boilers dropped a piece of lighted waste into a bucket of kerosene which was standing in the fireroom. He attempted to extinguish the fire by placing an empty bucket into the lighted one. An explosion followed. Result: Burns of the arms and legs. Twenty sick days.

Unsafe practice; ignition of floor wax.—While waxing a floor a man lighted a cigarette and accidentally ignited the can of wax which he was holding. Thirteen sick days.

Gasoline fumes, fatal poisoning by inhalation of.—Gasoline was being used to clean the air flask of a torpedo in a confined space. One man was asphyxiated and efforts to resuscitate him were unsuccessful.

Action was taken by the commander in chief, United States Battle Fleet, following the proceedings of a court of inquiry, to prevent

such accidents. He directed, by Battle Fleet letter No. 72-75, of October 31, 1925, that volatile liquids which give off inflammable, asphyxiating, or other dangerous fumes not be used in confined spaces or in such manner as to be dangerous to personnel or matériel, and that in all cases complete precautions be taken to safeguard personnel and matériel. Attention was also invited to Navy Department General Order No. 105, of May 3, 1923, and instructions and safety orders contained in Bureau Manuals.

HEALTH OF THE NAVY

The admission rate for all causes remained low through December, the last month for which complete returns are available. Admission rates for injuries were a little higher than corresponding rates a year ago, except for injuries connected with work or drill. There was a slight reduction in the rate for that class, whereas for accidental injuries sustained while men were on leave or liberty, and for injuries received within naval commands under other than work conditions the rates were definitely higher than 1924 rates. Compliance with the instruction that an admission to the sick list be recorded in any case of disease or injury if disability continues beyond the hour at which the next regular morning report of sick is prepared, doubtless is largely responsible for the slight increases in rates. In previous years it is probable that many minor injuries were treated for one or two days with the patient in the sick bay, followed by light duty or a few days on an excused list, without recording for statistical purposes.

In January and February, influenza and pneumonia were prevalent or epidemic in a number of cities of the United States. Indeed there seems to have been a worldwide increase in the prevalence of influenza. The medical officer of the United States Legation Guard, China, has recently reported that influenza of mild type was epidemic in Peking and reports also indicate that epidemics have occurred in various parts of Europe. The disease appears to have been late in affecting naval personnel. In January, only 37 cases were notified by all ships from which monthly communicable disease reports were received, but individual Form F cards which have reached the bureau seem to indicate that a good many cases developed in February and in the early part of March.

It is, of course, difficult in some instances to decide whether cases, even when occurring in outbreaks, should be recorded as influenza or as catarrhal fever. All naval stations in the United States notified 31 cases of influenza and 377 cases of catarrhal fever in January.

At the naval training station, San Diego, Calif., a sharp outbreak, comprising 137 cases notified as catarrhal fever, began early in January. Three cases of cerebrospinal fever had developed among recruits in the incoming detention camp December 4, 6, and 7, 1925. No more occurred until the outbreak of catarrhal fever, or influenza, had about reached its height, and then 9 more cases of cerebrospinal fever developed. One more case developed in the person of a hospital corpsman attached to the United States Naval Hospital, San Diego, Calif., to which the station cases were transferred. Coincident with the occurrence of an outbreak of acute respiratory infections at the United States Naval Training Station, Great Lakes, Ill., a case of cerebrospinal fever developed February 13, and that was followed by 5 in the latter part of February. Six more cases, making a total of 12, were reported by letter under date of March 12, 1926. So far, two of the San Diego and three of the Great Lakes cases have proved fatal. It is apparent that these outbreaks, considering the numbers of personnel exposed, have been relatively more extensive than most of the outbreaks that occurred in the Navy during the World War. The U. S. S. *Pennsylvania* notified one case of cerebrospinal fever in February.

In spite of the fact that this is a measles year for many cities in the United States, very few cases have been reported by naval organizations ashore and afloat up to this time, excepting the marine barracks, Parris Island, S. C., where an epidemic is in progress. The outbreak began January 30, and 46 cases had developed up to March 1, 1926.

Comparatively few cases of mumps have occurred in the Navy since the beginning of the year.

TABLE No. 1.—*Summary of morbidity in the United States Navy and Marine Corps for the quarter ended December, 1925*

	Forces afloat	Forces ashore	Marine Corps	Entire Navy
Average strength	74,056	37,870	19,046	111,926
All causes:				
Number of admissions	8,591	5,959	2,718	14,550
Annual rate per 1,000	464.00	629.39	570.81	519.87
Disease only:				
Number of admissions	7,461	5,120	2,342	12,581
Annual rate per 1,000	402.97	540.77	491.84	449.52
Communicable diseases, exclusive of venereal diseases:				
Number of admissions	1,477	1,676	761	3,153
Annual rate per 1,000	79.77	177.02	159.82	112.66
Venereal diseases:				
Number of admissions	2,780	818	489	3,598
Annual rate per 1,000	150.15	86.40	102.69	128.56
Injuries:				
Number of admissions	1,107	824	371	1,931
Annual rate per 1,000	59.79	87.03	77.91	68.99
Poisoning:				
Number of admissions	23	15	5	38
Annual rate per 1,000	1.24	1.58	1.05	1.36

Table No. 2.—*Deaths reported, entire Navy, during the quarter ended December 31, 1925*

		Navy			Marine Corps		Nurse Corps	Total
		Officers	Midshipmen	Men	Officers	Men	Nurses	
Average strength		8,368	1,741	82,116	1,162	18,056	483	111,926
CAUSES—DISEASES								
Primary	Secondary or contributory							
Aortic insufficiency	None			1				1
Appendicitis, acute	Peritonitis, acute general			1		2		3
Do	Poisoning, anesthesia ether			1				1
Do	Pneumonia, lobar			1				1
Arteriosclerosis, general	Angina, pectoris	1						1
Do	Hemorrhage, cerebral					1		1
Do	Nephritis, chronic			1				1
Atrophy, liver, acute	None			1				1
Bronchitis, acute	Pneumonia, broncho			1				1
Carbuncle	Pyemia			1				1
Cerebrospinal fever	None			4				4
Do	Pneumonia, broncho			1				1
Diabetes, mellitus	None			1				1
Focal infection (teeth)	Septicemia			1				1
Influenza	Pneumonia, broncho	1						1
Malaria	None					1		1
Myocarditis, chronic	Rupture, left ventricle heart.			1				1
Nephritis, chronic interstitial.	None			1				1
Pancreatitis, acute	do			1				1
Pneumonia, lobar	do	1				1		2
Do	Erysipelas			1				1
Pyelitis, acute	Septicemia			1				1
Thrombosis, right coronary	None					1		1
Tonsillitis, chronic	Pneumonia, broncho (following anesthesia).			1				1
Tuberculosis, chronic pulmonary.	None			3		1		4
Tuberculosis, general miliary.	Tuberculous meningitis			1				1
Syphilis	Dementia paralytica			1				1
Valvular heart disease	None			1				1
Neoplasms	do			2			1	3
Undetermined (acute respiratory infection).	Endocarditis, acute malignant.				1			1
Total for diseases		3		29	1	7	1	41
CAUSES—INJURIES AND POISONINGS								
Asphyxiation	None			2				2
Fracture, compound skull	do			4				4
Injuries, multiple extreme	do	1		8				9
Do	Fracture, simple skull			1				1
Do	Hemorrhage, traumatic brain.			1				1
Injuries, multiple, extreme	Hemorrhage, traumatic cerebellum.			1				1
Do	Hemorrhage, traumatic jugular vein.					1		1
Intracranial injuries	None			2				2
Rupture, traumatic, lung	Hemorrhage					1		1
Rupture, traumatic, kidney	do					1		1
Strangulation, neck (hanging).	None			1				1
Wounds, penetrating brain	do					3		3
Wounds, punctured	do	1						1
Do	do			3		3		6
Drowning	do	3		9		1		13
Do	Alcoholism, acute			1		1		2
Do	Intercranial injury			1				1
Poisoning	None			5				5
Total for injuries and poisonings		5		39		11		55
Grand total		8		68	1	18	1	96
Annual death rate per 1,000, all causes		3.82	0	3.31	3.44	3.99	8.28	3.43
Annual death rate per 1,000, disease only		1.43	0	1.41	3.44	1.56	8.28	1.46
Annual death rate per 1,000, drowning		1.43	0	.54	0	.44	0	.54
Annual death rate per 1,000, injuries		.96	0	1.12	0	1.99	0	1.25
Annual death rate per 1,000, poisoning		0	0	.24	0	0	0	.18

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SPECIAL ARTICLES

SELECTION OF PERSONNEL FOR SUBMARINES

By R. F. Jones, Lieutenant Commander, Medical Corps, United States Navy

In the investigation of the hygiene and sanitation of submarines it soon became apparent to the officers engaged in the work that too little attention was being given to the selection of personnel for this duty. Although regulations covering the salient points of physical requirements were in the Manual of the Medical Department and in Submarine Instructions, little regard was given to this important phase of submarine duty. In fact, officers and men were more frequently inducted into this service without any adequate physical examination than with a comprehensive one. Furthermore, those who were examined were often given only a cursory physical examination.

For 10 or 15 years much valuable and thoughtful study has been given to this subject by various medical officers working with submarines, among whom stand most prominently Lieut. Commander E. W. Brown, Medical Corps, United States Navy, and Commander E. F. DuBois, Medical Reserve Corps, United States Navy. Through the efforts of these officers many improvements were made in the hygienic conditions of submarines, and the regulations mentioned above were evolved. However, as stated before, apparently little regard was given to the selection of men for submarine duty at the time this work was commenced.

Rear Admiral M. M. Taylor, Commander of the Control Force and Submarines, Atlantic, realized soon after he took command that, in order to maintain the matériel of the boats in the highest state of efficiency, the personnel should be selected with due regard for the special type of duty they were to perform. The Surgeon General, Rear Admiral E. R. Stitt, Medical Corps, United States Navy, was also much interested in the general hygiene and sanitation of submarines, as well as the selection and maintenance of the personnel for such duty. In 1923 the Surgeon General detailed

several medical officers to submarine tenders and bases, with instructions to study various phases of the submarine problems as they related to the Medical Department. The first problem attacked was the general hygiene and sanitation of the boats, reports on which were forwarded to the Navy Department. One of these, "Ventilation of submarines in the Tropics," by Lieut. C. H. Mankin, Medical Corps, United States Navy, and the writer, was published in the United States Naval Medical Bulletin of June, 1924. It was particularly fortunate that we were able to do this work first, for it necessitated our taking cruises in submarines for prolonged periods and thus gave opportunity to observe the living and working conditions of the crews of these boats, both while on the surface and submerged. Every opportunity was made use of to investigate the effects of submarine duty on the physical body, and also what types of physique and mental qualities were necessary for this duty.

Physical Requirements for Submarines

In order to ascertain the physical requirements for this duty it was considered wise to determine what diseases or injuries were most prevalent among the crews of submarines and what diseases or detrimental effects could be definitely attributed to service therein. At first it appeared that various conditions of the eyes and ears could be attributed to duty in submarines, as had been stated by our predecessors. As this paper will show later, this is probably true with regard to the eyes, but it is doubtful if affections of the ears can be attributed to the same cause. Another effect upon the physical condition, which has been attributed to prolonged duty in submarines, is that upon the nervous system. This is unquestionably more marked in war than in peace. There are inadequate statistical data to prove that a person with a latent psychoneurosis should not be detailed for duty in submarines. Nevertheless, from my observations and experiences, I am convinced that this is a fact, for this type of duty, even in peace times, frequently requires the greatest courage and mental stability on the part of each member of the crew. Under such circumstances one may assume that those engaged in this work must be fit in every respect to withstand the frequent severe strains upon the nervous system.

From my observations of living conditions in submarines, and considering that during war the personnel will have rest periods, it seems that diseases of the systemic system, such as those affecting the heart, lungs, kidneys, etc., and the infectious diseases, possibly with the exception of tuberculosis, are no more liable to occur among the properly selected crews of these boats than in the general personnel of the Navy. However, it should be remembered that duty in a

submarine is extremely strenuous at all times and, as a result of fatigue, both mental and physical, and the relatively poor living conditions, *only men of first-rate physical and mental stamina will hold up under this strain.*

The present regulations governing the physical requirements for submarine duty are so vague that it is believed that they should be rewritten. Paragraph 1534, Manual of the Medical Department, is quoted herewith to show the existing regulations:

1534. Physical examination of officers and men prior to engaging in submarine duty:

(*a*) Officers and men detailed to submarine duty shall be given a careful physical examination.

(*b*) *Standards.*—The following conditions shall be sufficient cause for rejection for this duty:

(1) Any indication of unstable nervous system.

(2) Chronic nose and throat affections.

(3) Chronic or acute diseases of the middle or internal ear. Lessened hearing from any cause that can not be remedied. Careful examination of the ears shall be made of persons assigned to listening details.

(4) Offensive breath from any cause.

(5) Excessive or objectionable perspiration.

(6) Obesity.

(7) Defective vision from any cause. Particular effort should be made to detect latent errors, especially if the person is to be given a periscope detail.

(8) Any acute or chronic skin disease.

(9) Venereal diseases. Owing to the lack of facilities for treatment and danger of transmission due to close contact on board the submarine, it is necessary to exclude all persons suffering from any form of venereal disease.

(10) Obstinate constipation or diarrhea.

From the examination of 948 enlisted men and 97 officers detailed to the Submarine School, New London, Conn., who had previously been examined by naval medical officers in accordance with the provisions of paragraph 1534, I am convinced that these regulations are interpreted too leniently by such medical officers, and that they are interpreted too strictly by medical officers attached to submarine tenders and bases. Therefore, it is believed that more specific regulations should be adopted, and it was recommended to the Bureau of Medicine and Surgery that paragraph 1534 be changed to read as follows:

SUBMARINE DUTY

* * * Officers and enlisted men detailed for submarine duty shall be given a careful physical and mental examination before they are permitted to enter this service, and shall conform to the qualifications as specified below.

A. Physical and mental examination for officers and enlisted men entering the submarine service:

(1) *Eyes.*—Any pathological condition which may interfere with a periscope watch will be cause for rejection in the case of officers. *A minimum requirement of vision for officers will be 20/20 in both eyes.* Inasmuch as several

officers have been removed from submarine duty because of imbalance of ocular muscles, all officers shall be tested for such condition in accordance with paragraph 1551. The central color vision and field of vision for form and color shall be normal, the test for which shall be conducted in accordance with paragraphs 1558 and 1559. The minimum requirement for vision for enlisted men shall be 20/20 in both eyes for all men of the seaman's branch and 20/30 for all others.

(2) *Ears.*—Since "listening" is becoming of such importance to the submarine service, any pathological condition of the ears which may affect hearing shall be cause for rejection. All officers, and such enlisted men of the ratings of quartermaster, signalman, radioman, etc., who may be detailed as listeners, shall be tested either by tuning forks or the audiometer. The only permissible variation from the normal will be in the wave lengths of 64c and 8192c. double frequencies.

(3) *Nasopharynx.*—Any defect which may affect hearing or breathing is sufficient cause for rejection.

(4) *Mouth.*—Chronic tonsillitis and caries of the teeth shall be cause for rejection.

(5) *Neck.*—Goiter or pulsating vessels of the neck shall be cause for rejection.

(6) *Respiratory system.*—Owing to the nature of duty in submarines, particular effort shall be made to detect latent tuberculosis or other chronic diseases of the lungs, the presence of any of which shall be cause for rejection. In each case the family history should be carefully considered.

(7) *Circulatory system.*—Any pathological conditions of the heart or vascular system shall be sufficient cause for rejection. For details of the necessary examination of heart and vascular system see paragraph 1565 (f).

(8) *Abdomen and trunk.*—The following shall be cause for rejection: Acute or chronic gastritis, hernia, hemorrhoids, chronic obstinate constipation, and chronic diarrhea.

(9) *Genito-urinary system.*—Syphilis, gonococcus infections, chancroids, cystitis, and diseases of the kidneys or testicles shall be cause for rejection.

(10) *Build and appearance.*—Neither the obese nor the extremely thin are desirable for submarine duty.

(11) *Joints, bones, and muscles.*—Acute and chronic diseases or deformities of the joints or muscles shall be cause for rejection.

(12) *Skin.*—Chronic, incurable skin diseases shall be considered sufficient cause for rejection.

(13) *Nervous system.*—A careful neuropsychiatric examination shall be given to all officers entering the submarine service, and again to all officers when qualifying for command. Particular efforts, by means of inquiry into personal and family history, shall be made to detect any latent evidences of psychoneurotic make up. Any indication of unstable nervous system shall be considered cause for rejection.

Mental examination for enlisted men shall be similar, but may be less rigid.

B. Annual physical examination.

Submarine officers and enlisted men shall be given an annual physical examination during the months of January and June, respectively, identical to that given prior to entering the submarine service. Where officers or enlisted men have satisfied the professional requirements for qualification, and where physical disabilities have not proved detrimental to these men or to their service in submarines, disabilities may be waived. The question of the rejection of a qualified submarine man is left to the discretion of the medical examiner.

C. The results of such examination shall be entered in the health record of the officer or man examined.

The proposed changes in the regulations governing the physical and mental requirements of officers and men for submarine duty are specific and will eliminate men with physical and neurological defects before entering this service, and, as a result, it is believed that there will be fewer men lost at the time they are most valuable, *i. e.*, after having been in the boats for more than a year.

When it is considered that practically every man examined at the submarine base, New London, Conn., had been examined in accordance with paragraph 1534, Manual of the Medical Department, by medical officers prior to their reporting to this station, and that, out of a total of 948 enlisted men examined, 110 were rejected for physical disabilities, it is apparent that there is a necessity for a change in the existing regulations. During the same period of time 97 officers were examined prior to entering the Submarine School for Officers, and out of this number eight have been rejected for physical disabilities or neurological reasons. This seems to show that more specific physical and mental requirements are also necessary for officers.

Of the eight officers rejected, three rejections were on account of defective vision; one on account of defective vision and restricted color vision; one on account of possible latent tuberculosis; one on account of floating cartilage of the knee (this officer having since entered the submarine service, cured by operation); and two on account of neurasthenia. Of the 110 enlisted men rejected, 49 were rejected on account of deafness; 14 on account of otitis media; 16 because of defective vision; 1 because of mitral insufficiency; 3 on account of possible latent tuberculosis; 3 because of chronic gastro-intestinal diseases; 3 because of neurological conditions; 1 had chronic rheumatism; 4 had chronic skin diseases which had failed to respond to treatment over a period of from six months to three years; 11 because of active syphilis; 2 had active gonorrhea; 1 had defective teeth; 1 gave a history of chronic alcoholism; and 1 had a perforated hard palate due to syphilis.

In a previous paragraph it was implied that such conditions as poor vision, defective hearing, and middle-ear diseases were possibly due to duty in submarines. From data presented in the paragraph above it now appears that some of these defects, for which men were previously discharged from the submarine service, may have existed prior to the time they entered this service.

The officers of the Navy who have not had experience with submarines apparently have little conception of the highly specialized type of duty required of men in this service. Each man has a definite job, and in some instances, when he falls out of position, the watches have to be stood "heel and toe," and sometimes continuously.

Furthermore, when a boat dives, the success or failure of the dive depends on each man functioning at his individual diving station. Moreover, when it is considered that practically all of the submarines in commission, with the exception of the two V-boats, have a war-time complement of 40 men—and it should be added that, with the available space, no more could be accommodated—it may readily be seen that the loss of a single man would materially cripple the efficiency of the boat. In other words, a ship with a large crew can lose one of its men without other members of the crew suffering hardship, whereas the loss of a single man in a submarine is a serious loss to the boat.

Owing to the fact that there is no representative of the Medical Department on any of the submarines, other than the V-boats, and that they are frequently separated from the division medical officer over a period of a week or two, it is essential that only those in the best of physical condition should be permitted to remain in this type of vessel. Furthermore, habitability, while at sea, is poor, the living spaces are crowded, and the ventilation, as installed at present, is inadequate.

As stated previously, particular attention should be given to the eyes and ears. The eyes are of especial importance on account of living in artificial light so much of the time, and, in the case of officers, the severe strain placed on the eyes as a result of the use of the periscope. In addition, each man of the seaman branch must have good vision without the use of glasses, as he is frequently the only person on the bridge other than the helmsman and the officer of the deck. If one should go into a submarine and see the machinery installed in such small space and remain therein during diving operations, when the boat sometimes becomes fogged by water vapor, he would realize, without further argument, the necessity for reasonable good vision without the aid of glasses for the entire crew.

In so far as the ears are concerned, a man in a submarine must have perfect hearing, and anything which might impair hearing should be cause for rejection, because, as stated before, each man has a very important duty to perform on his individual station, and, in most instances, this duty has to be performed in obedience to a verbal command. As a result of the realization by all officers connected with submarines of the necessity for good hearing among officers and men performing duty therein, it was decided to accept for the Submarine School only men who had been tested by tuning forks or the audiometer. Without question, any man detailed as a listener should have absolutely normal hearing as well as excellent binaural sense.

It has often been stated that deafness may be attributed, under some circumstances, to duty in certain types of submarines, but,

notwithstanding investigations of the personnel living therein and several cases of deafness attributed to such service. I have never seen a single case of deafness which could definitely be traced to this duty. However, each of these cases believed that his deafness was brought on as a result of this duty, but, when carefully questioned, admitted previous injury to the ears by gun-fire, diving under water at high pressure, hereditary influences, etc., all of which are known to be contributory factors to deafness.

The last factor to be considered, and by no means the least important in selecting men for submarine duty, is their mental and neurological makeup.

Mental Requirements for Submarine Duty

From what has been said it is quite obvious that not only must the men attached to submarines be in the best possible physical condition, but, with the duties to be performed, as briefly described above, it is essential that the enlisted men be chosen with a view to their mental caliber and nervous stability. Those of long experience in submarines are convinced that only men who have mental capabilities for petty officers should be inducted into this service. To reiterate, it must be borne constantly in mind that every man in a submarine has a definite, distinct function, and upon the proper performance of this duty depends the safety of the boat. This is particularly true during diving operations. Furthermore, each man must have the mental capabilities to master the intricacies of the many valves, tanks, air lines, pumps, etc., necessary for diving and raising the boat, for the time may come when his life as well as the lives of his shipmates will depend upon this knowledge.

With these facts before us, an endeavor has been made to select men for this duty who are capable of being petty officers and who have the necessary native ability to receive and profit by the instruction and training of the Submarine School, New London, Conn., through which all men now entering the submarine service have to pass.

Before analyzing the results of the mental test for the selection of men for the submarine service which has been in use at this station for more than a year, the method of giving the test and why the one used was adopted will be briefly considered. Any test for intelligence, it should be understood, has its limitations and is of no value unless carefully supervised. Unquestionably the best test of a man's ability is the "trial and success or failure" method, but this is uneconomical. The next best test is the personality study of each individual; but since this is time-consuming on the part of both the examiner and the examinee, it is impracticable where a large group of men are to be examined. Therefore some group-intelligence test is

advisable. Before finally adopting the O'Rourke Intelligence Test, which had been adopted by the Bureau of Navigation, various other mental tests were considered. Letters were also written to several psychologists for their advice. It may be added that the cooperation received from these men was most gratifying. Of all the tests considered, that devised by Dr. A. W. Stearns, as outlined in the NAVAL MEDICAL BULLETIN of February, 1924, was considered to be the most desirable. Inasmuch as the printing of the forms for this test would be costly, and since the psychologists who had been consulted stated that it did not make a great deal of difference which test was used, provided it was a recognized one, given in an intelligent manner, and its limitations realized, the O'Rourke test was accepted. After using this test for two or three months Doctor Stearns was requested to visit this station and to comment on our methods. He agreed that it would be just as well to continue in the use of the O'Rourke test, but emphasized the necessity of controlling it as outlined below.

The method of examining men at this station is briefly as follows: Groups are limited to 10, and at most, when rushed, to 15 men. The men are first given the physical examination in accordance with paragraph 1534, Manual of the Medical Department, and the modifications recommended above. Regardless of whether or not a man meets the physical requirements, he is given the intelligence test. Upon the completion of the physical examination each man is placed at a separate desk and the mental test given. The men, upon the completion of the examination, are dismissed and return to work. All papers are graded, and the card shown below is completed, most of it having been made before and during the physical examination:

UNITED STATES NAVAL SUBMARINE BASE,
NEW LONDON, CONN.,

No. ------. Date ---------------------.

Name: ---------------------. Rate: -----. Age: ----- years ----- months.

Date first enlisted: ---------------------. Date recommended for rating; qualified; rated: --------------------. Previous duty: ------------------------
(Battleships, destroyers, etc.)

Requested submarine duty: ------.

Service record: ---
(Clear—offenses.)

Naval trade schools: -------------------------------. Completed: --------
(Date.)

Civil condition: Single, --------. Married, --------. Divorced, --------. Appearance, --.

Education: Last school grade completed, ------. Age at time, ------. Previous occupation, ------------------. Medical history, -----------------. Alcoholism, ------. Arrests (civil life), ------. Physical defects: ---------.

Submarine School standing: --
(Filled out after graduation from school.)

Final fitness: Physical, ---------. Mental, ---------. Educational, ---------. Industrial, ---------.

Any man who fails to meet the physical or mental requirements is then recalled. If physical defects, other than those which do not require reexamination, have been noted, these are checked—for instance, defective hearing is sometimes checked three or four times—and, if considered of sufficient importance to preclude the man from submarine duty, rejection is noted on his card. Those failing on the intelligence test, i. e., with a mark below 45, are given a personality study and, if after such examination it is considered that the man has the necessary intelligence for submarine duty, he is recommended to enter the Submarine School on trial.

For convenience in compiling statistical data relative to the mental test, the following system of marking was adopted: 0 to 44 per cent=1; 45 to 64 per cent=2; 65 to 84 per cent=3; 85 to 100 per cent=4.

Before the adoption of this system of examination of enlisted men entering the Submarine School, about 20 per cent were dismissed from the school for inaptitude, whereas, since its adoption, only about 1 per cent have been dismissed and the majority of the men found to be inapt were among those on trial.

From December 1, 1924, to December 1, 1925, 948 enlisted men have been examined prior to entrance into the Submarine School. Of this number, 160 have been rejected for physical defects or mental inferiority. Six hundred and fifty-eight of the remaining 788 have graduated from the Submarine School. Seventy-two men are now in the school, 20 men were transferred to other activities after being examined and never entered the school, 5 men were discharged by special-order discharge, 7 men deserted after entering the school, 8 men were dropped for inaptitude, inattention to school work, etc., after entering the school, and 18 men who have passed the physical and mental tests are now awaiting instruction.

Of the 948 men examined, 645, or 69 per cent, requested submarine duty. However, many of the 282 who did not request this duty declared a preference for submarines after arrival at this station.

Two hundred and fifty-eight of those examined had already completed a course of instruction in a trade school conducted by the Navy. Of those who had previously attended a naval trade school, 12 made a score of 1 on the intelligence test, 37 made a score of 2, 97 made a score of 3, and 112 made a score of 4.

The table following shows the relation of the school grade completed to the mark made on the intelligence test:

	First to seventh grade	Eighth grade	First to third high	Graduated high
1	107	40	----------	----------
2	123	92	39	1
3	79	123	113	10
4	15	65	100	41

It will be seen from the table above that, whereas the score made on the intelligence test has a fairly definite relation to the school grade completed, men of higher intelligence are able to make good marks on the intelligence test regardless of previous education. For instance, one man who had completed only the third grade, grammar school, made a mark of 95 per cent on the intelligence test. It will also be noted that none of the men who had entered high school made less than 2, or 45 per cent, the required standard.

The table following shows the relation of the intelligence test to the military record, which was obtained from the service record of each man at the time of examination:

Score	Reduced in rating at the mast	One-deck court	Two or more deck courts	One summary court-martial	Two or more summary courts-martial	General court-martial	Arrests in civil life	Service record clear
1		37	3	26	11	4	2	61
2		25		27	3	3	7	213
3	3	21	2	17	8	2	7	254
4	2	7	2	4	3	2	1	191

It will be noted above that 42 per cent of the men who made a score of 1 had clear records, 76 per cent with a score of 2 had clear records, 81 per cent with a score of 3 had clear records, and 92 per cent with a score of 4 had clear records. This is very significant and seems to prove that there is a definite relationship of degree of intelligence to the conduct of the individual. However, it must be remembered that there are not sufficient data from which any definite conclusions may be drawn.

The next table shows the relation of the score made on the intelligence test to the various ratings held by the men examined:

	A. S.	Sea. 2c	Sea. 1c	Cox.	B. M. 2c	B. M. 1c	C. B. M.	F. 3c	F. 2c	F. 1c	Eng. 2c	Eng. 1c
1	1	38	42		2	4		5	3	6	18	8
2	6	58	79	2	4	8	2	6	1	16	11	15
3	1	62	84	2	4	2	2	23	4	9	14	13
4	2	51	38	2	2		2	27	7	6	4	4

	M. M. 2c	M. M. 1c	C. M. M.	W. T. 2c	W. T. 1c	E. M. 3c	E. M. 2c	E. M. 1c	C. E. M.	R. M. 3c
1	6									
2	6	8	2			5	2	3		2
3	9	10	1	1	2	11	3	3		5
4	10	4	2			9	6	3	1	14

	R. M. 2c	R. M. 1c	C. R. M.	T. M. 3c	T. M. 2c	T. M. 1c	C. T. M.	G. M. 3c	G. M. 2c	G. M. 1c
1				3	1					2
2	1			4	2	4	1	3	6	3
3	2	2		6	5	9	4	4	2	4
4	6	4	1	3		4	2	1	1	1

	Q.M.3c	Q.M.2c	Q.M.1c	C.Q.M.	S.M.3c	S.M.2c	C.S.M.	S.C.3c	S.C.1c	Ph.M.1c
1		1		1				1		
2	1	3	1					3	1	
3	2	2	4		1	3	1		1	
4	3		1	3						2

Owing to insufficient data, this table is not considered of any great value. It does seem to show, however, that men of the enginemen ratings have less intelligence than men of corresponding petty officer ratings.

The table following shows the relation of the grade made by the men completing the course in the Submarine School to their marks on the intelligence test:

	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.[illegible]
1	8	3	2	2	2	3	4	4	5	7	6			
2	10	3	5	2	13	11	13	27	16	32	23	2	4	4
3	1	2	4	4	19	26	26	16	38	47	54	24	12	11
4			1	4	6	5	8	21	23	25	30	16	10	12

From the above table it has been calculated that of the men making a score on the intelligence test of 1, 44 per cent made a mark of less than 3 in the Submarine School, 55 per cent made a mark of from 3.1 to 3.5, and 1 per cent made a mark of from 3.6 to 3.8. Of those making a score of 2 on the intelligence test, 26 per cent made less than 3 in the Submarine School, 69 per cent made between 3.1 and 3.5, and 5 per cent between 3.6 and 3.8. The percentages for those making a score of 3 on the intelligence test were 20 per cent, 64 per cent, and 16 per cent, and for those making a score of 4, 10 per cent, 66 per cent, and 24 per cent. These figures show that, as a general rule, there is a definite relationship between the score made on the intelligence test and the probable standing in school.

The table below shows the physical condition of men examined as related to the score made on the intelligence test:

	1	2	3	4
Deafness	21	11	14	3
Otitis media	4	6	2	2
Defective vision	5	5	4	2
Heart conditions	1			
Lung conditions	3			
Gastrointestinal	2		1	
Nervous conditions	3			
History of rheumatism	1			
Chronic skin diseases	2		1	1
Syphilis	9	2		
Gonorrhea	2			
Defective teeth		1		
Chronic alcholism		1		
No physical defects	91	252	291	205

An analysis of this table shows that of the 110 men rejected for physical defects, 48 per cent made a score of 1 on the intelligence test, 24 per cent made a score of 2, 20 per cent made a score of 3, and 8 per cent made a score of 4. One hundred and three men were rejected for mental inferiority, and of this number, 53 had physical defects of sufficient degree to eliminate them from entering the submarine service. In other words, only 50 men were rejected on account of mental inferiority alone.

Whereas the data thus far accumulated are too limited to warrant any definite conclusions, they certainly seem to show that the personnel of submarines may be improved as a result of such a system of selection as has been used at this station. It has been impossible to obtain definite information as to whether or not there has been any improvement in the quality of the personnel of submarines since selected men have been sent to the boats, but there has been a general expression of opinion of all commanding officers consulted, that the men now received from the Submarine School are of better quality, physically and mentally, than before this work was commenced. It would be extremely difficult to obtain accurate data of this nature, although such are necessary to prove conclusively the results of any selective system.

It is stated in the proposed revision to the Manual of the Medical Department: "A careful neuropsychiatric examination shall be given all officers entering the submarine service * * * mental examinations for enlisted men shall be similar, but may be less rigid." It is essential that officers, with far greater responsibilities than enlisted men, should be selected with greater care with regard to their psychiatric makeup. However, enlisted men with latent psychoneurotic conditions are not desirable for submarine duty. It is impracticable to give each enlisted man the careful neuropsychiatric examination given officers. (The form for the physical and mental examination of officers, as used at this station, is appended, marked "Appendix A.") It has been the experience here that it is rarely necessary to give such an examination to the enlisted men, except those making a score of less than 45 on the intelligence test. As a result, the routine has been adopted of making this examination on men who failed to pass the intelligence test, i. e., those making a score of less than 45. No doubt, as a result of this method, some enlisted men with scores above 45, and who have latent psychoneuroses, enter the school but, since such an examination requires from one to two hours to complete, it would not be possible to give this examination to each individual reporting here for the Submarine School. Fur-

thermore, enlisted men are kept at this station, under instruction and awaiting assignment, from one to two months before being definitely detailed to submarines, and during this time they would probably show their psychoneurotic tendencies.

It is the consensus of opinion of officers with considerable experience in submarines that the temperamental qualities of officers should be considered in detailing them for this duty. In the neuropsychiatric examination of officers this point has been constantly kept in mind and, if any qualities have been noted which might be considered as making them less desirable for duty on board a submarine, these facts have been brought to the attention of the officer in charge of the Submarine School. After the examination of 97 officers for entrance into the school, and many officers for qualification for submarine duty, it has been decided that this may better be determined by line officers with experience with submarines. However, it is felt that the medical officer should cooperate, as during a properly given neuropsychiatric examination many points of value to the line officer in reaching his conclusions may be elicited.

Conclusions

1. The personnel of a submarine should be of higher physical and mental type than is required among the general personnel of the Navy.

2. Before entering the submarine service, and once a year thereafter, all officers and enlisted men should be given a careful physical examination and only those meeting the physical requirements should be selected for this service or retained.

3. All officers entering the submarine service should be given a neuropsychiatric examination and those with any indication of a later development of psychoneuroses should be rejected.

4. All enlisted men entering the submarine service should be given the intelligence test along the general lines used at the Submarine School, New London, Conn., and, when considered necessary by the examining medical officer, a neuropsychiatric examination.

5. The temperamental qualities of officers should be given more consideration, and when an officer is considered temperamentally unfit for the submarine service by the line officers acting as instructors in the Submarine School, such offiecr should not be detailed from the school to active submarine duty. This is not considered the function of the Medical Department.

6. The Manual of the Medical Department, relative to requirements for submarine duty, should be revised as recommended above.

APPENDIX A

PHYSICAL EXAMINATION OF OFFICERS ENTERING SUBMARINE SERVICE

_________ _______________ _________U. S. N. Age______years______months.
(Surname.) (Christian name.) (Rank.)
Character of previous duty____

Family record

	Age if living	Health	Age at death	Cause of death		Age if living	Health	Age at death	Cause of death
					Brothers________				
Father__________									
					Sisters_________				
Mother__________									

Personal medical history

Diseases or injuries	Date	Duration	Complications

The above to be filled in by candidate.

General examination

Build and appearance ____
(Posture, figure, frame, cyanosis, obese, emaciated.)
Temperature______________. Height_______inches. Stem height_______inches. Weight______pounds. Bones, joints, and feet_______________________________ Skin___________. Glandular system___________. Hernia___________. Hemorrhoids_________.

Cardio-vascular system

Condition of arteries___________. Character of pulse___________. Condition of veins__________. Pulse rate per minute: Prone______; standing______; after exercise_________. Blood pressure; prone: Systolic________; diastolic________. Standing: Systolic______; diastolic______. Circulatory efficiency rating___________________. Heart (abnormal sounds, thrills, arrhythmias, murmurs, enlargements, etc_____________________________.

Respiratory system

Chest measurements: Expiration________inches. Inspiration________inches. Normal circumference_______. Inspection____________. Palpation__________. Percussion__________. Auscultation__________. Vital capacity__________.

Abdomen and digestive organs

History of digestive disturbances____________________. Constipation_______. Previous operations________________. Physical abnormalities (viscera)_____________________________________.

Ears

History of ear trouble --.
(Severe injury to head, ringing or buzzing of ears, headaches, etc.)

External auditory canal: Right------------------. Left------------------.

Membranae tympani: Right-------------------. Left-------------------.

Hearing. (Audiometer—percentage loss.)

Right	------	------	------	------	------	------	------	------
	64_c	128_c	256_{c_1}	512_{c_2}	1024_{c_3}	2048_{c_4}	4096_{c_5}	8192_{c_6}
Left	------	------	------	------	------	------	------	------
	64_c	128_c	256_{c_1}	512_{c_2}	1024_{c_3}	2048_{c_4}	4096_{c_5}	8192_{c_6}

Mouth and nasopharynx

Mouth—Teeth:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

(Strike out missing teeth with X, decayed with /.)

Calculus--------------------. Pyorrhea----------. Stomatitis----------
(Slight, medium, large.)

Condition of nares: Right--------------------. Left-------------------.

Condition of tonsils and history of tonsillitis----------------------------------.

Presence of adenoids---.

Eustacian tube (patulous or not)---.

Genito-urinary system

History---.

Inspection ---.

Urinalysis: Reaction----. Specific gravity----. Albumin----. Sugar----. Microscopic----.

Eyes

Inspection: Pupil equality----. Shape----. Reaction-------------------.

Visual acuity: Right eye----------------. Left eye----------------------.

Maddox rod test, 20 feet. Eso---------------d. Exo------------------d.

Maddox rod test, 13 inches. Eso---------------d. Exo---------------d.

Prism divergence--d.

Accommodation: Right éye------------------. Left eye-----------------.

Central color vision: Right eye----------------. Left eye----------------.

Field of vision, form: Right eye------------. Left eye------------. Color: Right eye----------. Left eye----------.

Refraction (homatropin if necessary): Right eye reads 20/20 with--------------------; true correction----------------------. Left eye reads 20/20 with-----------------------; true correction-----------------------------.

Ophthalmoscopic examination: Right eye-----------; left eye-----------.

Neuropsychiatric examination

Family history--.

Personal history and habits---.

Fainting-------------. Headaches--------------. Dizziness--------------.

Somnambulism------------. Insomnia-------------. Dreams------------.

Enuresis----------. Stammering------------. Memory------------. Will grasp----------. Phobias----------. Anxieties----------. Conflicts--------. Complexes----------. Depression----------. Apathy-------------. Elation ----------. Station----------. Patellar reflexes----------. Tic----------. Tremor--------------. Psychomotor tensions-------------- Peripheral circulation----------. Impression----------.

Result of examination

Defects______________________.
Is candidate qualified for submarine duty__________.
Recommendation of board____

SPECIALISM IN THE NAVY MEDICAL CORPS—A REVIEW

By N. J. BLACKWOOD, Captain, Medical Corps, United States Navy

Eleven years ago the present writer published a short paper in The Military Surgeon of February, 1915, entitled "The advisability and practicability of specialists in the Medical Corps of the Navy."

Upon reviewing that paper, he finds he is of very much the same opinion on the broad general principle as he was at that time. But "much water has passed under the bridge" in the past 11 years, conditions have materially changed, new activities have been forced upon the Medical Corps of the United States Navy, and the duties of the naval medical officer to-day are far different from those prior to the Great War.

In those days we had no Veterans' Bureau patients; there was no probability of our hospitals taking care of dependents of officers and enlisted men; and the size of the corps was very much less than it is to-day.

The subject, therefore, must be viewed from two different angles, whereas one angle seemed sufficient at that time. From the viewpoint of the essential duties of a military surgeon in the United States Navy, the opinion as to the necessity or advisability of specialists is very much the same as it was in 1915, but, in order to perform the duties which are now required of naval medical officers, the viewpoint has changed and there is a necessity for more specialization, and more specialists of certain types are required than before. The same object which dictated the qualifications of military surgeons—namely, to keep men fit to fight—should be the object of that specialty to-day, and in order to do that, the specialist, except in limited numbers, is not required. It should not be the endeavor or hope of the naval medical officer to make wonderful cures of cases which, when cured, will not be fit for service, nor to do elaborate surgical operations which, when completed, only save a life but do not make a fighting man.

It would be a foolish and shortsighted policy to make hard and fast rules for the corps to-day which to-morrow would have to be entirely upset, because conditions in the practice of medicine and in the development of the Navy are so rapidly changing that what

would be wise to-day might be totally inappropriate and inefficient to-morrow. One has only to look back over the past 10 years to see the hundreds of examples of the truth of this statement.

The ideas that will be expressed in this paper are those which are derived from 11 years' experience in command of naval hospitals and hospital ships and are from that viewpoint chiefly, backed by 35 years of service in all kinds of duties in the Navy, both ashore and afloat, including 14 years of the latter which, however, were largely at a time when conditions were far different from those at present.

The papers that the present writer has been able to read on this subject recently have apparently been written from the viewpoint that we have not enough specialists and that we ought to get more, whereas his viewpoint is that we have too many so-called specialists now and ought to have more general practitioners, generally trained in all duties and only a limited number of real specialists in the major specialties of medicine. Other articles are written with the idea that once a specialist, always a specialist, and that military medicine is not a specialty, whereas it is his contention that military medicine is one of the most important specialties, embracing many specialties in civil life, and is the most essential one for medical officers of the Navy; also that a man may pay special attention to one of the subdivisions of general medicine at different periods of his life's practice, rendering excellent services during that time, and yet not be a specialist, but only raise his standing as a military surgeon.

Viewing specialties in civil life, the great trouble seems to be that a very large proportion of so-called specialists are so in name only, and have neither a good foundation of general medicine nor any great degree of knowledge of any specialty. They are men who have graduated from medical colleges with the fixed intention of practicing only on certain portions of the body and they have directed their attention to the diagnosis and treatment of the diseases of those organs to the neglect of the principles of general medicine and then, after an intensive course of from one to six months, presume to call themselves specialists and practice on the gullible general public. They, therefore, view their practice and their specialty from a very narrow angle and are only fitted to take care of patients who have been thoroughly gone over by a broadly trained general practitioner or by specialists in various fields, who have decided that the disease is one for this particular specialist. Such specialists only bring discredit upon the medical profession, and more often fail than succeed in the treatment of their cases, because they haven't the proper groundwork in general medicine. Take the

case of dentists, who are certainly specialists. The field of dentistry has been so enlarged in the past few years that it has now come to the point of being regarded as a most important specialty in general medicine and oral surgery, and the diseases of the teeth play a most important part in the diagnosis and treatment of conditions which a few years ago were never supposed to have any connection with the teeth. But, with the exception of a rather limited course in the principles of medicine, the dentist is graduated as an operating odontologist and he is not properly taught the principles which underlie the great science of medicine. If he were required to pass through the same course of study in medical colleges as other specialists in medicine, he would have a groundwork which would enable him not only to aid in making, but to make original diagnoses, the causes of which lie in the teeth. He would then be a specialist in medicine, on a par with all other specialists, and would take his place in the great group of medical men, and not in a separate and distinct profession.

This idea is not entirely original with the present writer, but is also the expressed opinion of some of the best leading dentists in the State of New York, men who have the interest of their profession at heart and who desire to see it placed in the position which it deserves. This change has been the endeavor of the Medical Corps of the Navy, as is demonstrated by the special course given to members of the Dental Corps at the Naval Medical School. If we could require our dentists to have an M. D. degree before entrance and could qualify those already in the service for that degree, we could amalgamate the two corps, and those having dental training would be specialists just the same as those in opthalmology, urology, surgery, or any of the other recognized specialties already embodied in the corps. Think what that would mean to the general efficiency, happiness, and contentment of those in the service.

No man should be allowed to practice a specialty until he has been not only thoroughly grounded in his student life in the broad principles of medicine, but until he has served an interneship and had an opportunity to practice the principles taught in the schools. He might then select his specialty, realizing that as the perfect tree develops from the seed, the roots, and the stem, and then branches out in all or particular directions, but still gets its principal nourishment from the fundamental roots, so the perfect military surgeon or the real specialist develops from the school of general medicine and must always keep closely in touch with the fundamentals of medicine, expanding through that nourishment, and

must remember that if he lops himself off from the main tree he will die, and his specialty be no longer a part of medicine, but a weak and inefficient offshoot without strength or sustenance.

In a recent speech, the president of the board of trustees of Jefferson Medical College, said that Jefferson, for the future, would not try to train specialists but would use its best endeavors to graduate general practitioners.

The country at large is to-day suffering from overspecialization in medicine and a lack of general practitioners. Thus, the small towns and villages are to-day advertising for medical men to come and practice in their community, not as specialists but as family practitioners. The need for this type of medical man is becoming more and more urgent every day and this demand must and will be filled and the specialist will be confined to the larger cities, and to towns which are already supplied with general practitioners.

But there is a very great difference between specialism in civil life and in the service. In civil life, the specialist is a specialist for life, whereas in the service, he may be a specialist for only a time, as part of his specialty of military medicine, and there is no necessity nor is there any call for a specialist of national or world-wide reputation in the service. The man with a good general education and a certain degree of special knowledge can handle successfully all emergency cases that arise in the service under most conditions and the few isolated cases which require more expert knowledge can easily obtain this from the few who are allowed to specialize to a greater extent, or by consultation with civilian specialists. The naval medical officer should not aim to be a great specialist but should aim to be a great military surgeon and coordinator who furnishes to his patients the best that general medicine can give, in the way of treatment and advice, in the saving of life and limb, and, when a point has been reached beyond his powers, in directing his patient to those who have been able to devote their whole lives to the study of some small portion of the human body.

Many of the conditions which confront the naval medical officer to-day are entirely outside his duties as a military surgeon and have nothing to do with that specialty. The military surgeon deals with normally healthy selected men and the emergencies of military life, whereas to-day, by acts of Congress and pressure from the service, he is now required to deal with diseases and conditions in civil life among men who, physically, never should have been taken into the military service, and with women and children. The interjection of the ex-service man of all ages and all physical conditions, and the proposed treatment of dependent women and children in our

hospitals, have placed a burden on the naval medical officer entirely aside from his duties as a military surgeon, and yet a condition which by law he is required to meet and which he desires to meet with credit to himself and the corps.

This means an active change in the requirements for naval medical officers and a certain number of highly trained specialists along certain lines. How are we going to meet this situation? In all of our hospitals taking care of Veterans' Bureau patients and women and children, we must have a Chief of the Medical Service who is a real specialist in internal medicine; a Chief of the Surgical Service who is a highly trained general surgeon, both in diseases of men and women; an ophthalmologist and aurist; a urologist; and obstretrician; and a pediatrist—the other specialties such as X ray, laboratory, and physical therapy being necessary in the requirements of a good military surgeon. These specialists should be held to their specialties and should, when they determine thus to specialize, willingly renounce all expectations of doing anything else until they reach command rank, when by their long and intimate contact with medicine, both specially and generally, they will be fitted to take command, after a short tour of duty as executive officer, to enable them to visualize the administrative side from actual contact.

The most important specialty of the true military surgeon, to my mind, is administration, and all efforts of the bureau should be directed to preparing men for that important duty. No man should ever be allowed to command a hospital who has not served in all the minor positions in hospital duties, from ward officer up through chief of service and executive. He should have had a good general experience in all the departments of medicine and should have shown some special ability as an administrator. He must be a general consultant in all the departments not only in an administrative way but medically. None but a medical man could ever command a naval hospital because its administration is so intimately tied up with medicine that the two can not be separated. The man without medical knowledge must fail as commanding officer of a naval hospital. In this respect he differs from the superintendent of a civil hospital. The latter has nothing to do with the treatment of patients, has no authority over the visiting staff, is not consulted about patients, does not give his consent to operations or admissions or discharges of patients. He is a trained hospital housekeeper and in some instances is not a medical man at all, whereas the commanding officer of a naval hospital is as vitally concerned with the treatment of the patients and with their food, as he is with the equipment and upkeep of the hospital.

How are we to get these specialists and how train them to perform these new duties at hospitals and shore stations? With our present interne system, one of the most beneficial and progressive things that has been done for the medical corps in years, with a steady yearly addition of young blood coming into the corps we can really plan for the future and adopt a policy which we may reasonably hope will be followed by succeeding generations of surgeon generals and naval secretaries.

After the year's interneship, all the internes remaining in the service should at once be sent to sea, preferably on a battleship, where they will still be under the guiding hand of a senior medical officer, there to become imbued with Navy customs, requirements, and the spirit of the service and where they can get some idea of the true duties of a military surgeon. During their interneship they should have been so instructed that when they go aboard ship they will not be absolutely green, but will be familiar with the ordinary routine and requirements of ship life. One or two of the internes from each class, in each hospital, should be retained in that hospital for another year as senior internes; their duties being to guide the new class of internes, giving them special attention under the direction of the officer in charge of interne service, and also to give them the benefit of more intensive training, especially along administrative lines. These senior internes should be specially selected as representing the best all-around men in the class. After a full two years at sea, these ex-internes should be again distributed, preferably to hospitals, to serve as ward officers and assistants in the various departments. During this tour of duty the special qualifications and predilections of these young officers will develop and should be encouraged, but not at the expense of other lines of work. Their service should be varied and they should have at least one year in each of the three major services, with opportunities at all of the auxiliary departments, and a careful record should be made of their work and tendencies. Again they should be sent to sea, this time for independent duty or on hospital ships.

When they return from this cruise, they should be well-rounded military surgeons and can then be selected for special training in any of the specialties for which they have shown aptitude and liking. Numbers of these men will prefer to remain general practitioners, some will want to be administrators, others will want to become specialists. In accordance with these decisions their future in the service should be determined. Much of the training in specialties can now be gotten in our largest naval hospitals, where the clinics are equal to or superior to most hospitals in civil life. This training can be supplemented from time to time by special intensive courses

at some well-selected school or hospital and eventually a well rounded and properly trained group of specialists will be evolved.

Another principle, which is a sine qua non to success, is that after every cruise, no matter to what duty a medical officer is to be assigned, he shall be sent first to a naval hospital for at least six months, two months of which shall be spent in each of the three major departments of the hospital, in order that he may become familiar practically with the changes and advances in medicine and hospital treatment, during the time that he had been at sea. No man, not even the most conscientious, can keep up while at sea, except by reading, and then he lacks the practical touch and visual demonstrations of the theories expressed by the writers. It is, therefore, absolutely necessary, unless he is to be left in the ruck, that he should be given this opportunity. After this period of hospital duty, he will be prepared to perform his duty wherever he may be needed.

It is not necessary that all officers in a department of a hospital should be specialists; in fact, it is much better that they should not be. But the head of each department should be as highly trained a specialist as it is possible to get, and his senior assistant should be one who desires to follow that specialty; but the other officers can be men with no special training and with no special desire for that specialty. The responsibility rests with the chief of the service and the head of the department and it is his duty to see that his patients receive the proper care and treatment.

This is but a brief outline of a very comprehensive subject, of which there are many details to be worked out, too numerous to be even touched upon in such a paper as this, and further, there must of necessity be numerous exceptions made, at least at first, to the hard and fast rules determining a policy. But with such a policy, and a sincere desire and determination to carry it out in principle, the perplexing problem of specialists will be solved and the new conditions forced upon the Medical Corps of the Navy will be met.

This plan will require but nine fully trained specialists for each of our class A hospitals and hospital ships, about 12 partially trained specialists as assistants and in the auxiliary departments, and a proportionally smaller number for class B and C hospitals, leaving the vast bulk of the officers of the corps to do the duties of a military surgeon aboard the ships of the fleet, and at various shore establishments throughout the world.

With this concession to those who believe we should all be specialists, I still claim that as military surgeons doing our legitimate duties in the Navy, we need no specialists, but broadly trained and educated medical men who are experts in their own specialty.

BOTANIZING IN HAITI[1]

By Dr. E. L. Ekman, of the Museum of Natural History, Stockholm, Sweden

Some time ago the secretary of the Société d'Histoire et de Géographie d'Haiti, Dr. Catts Pressoir, took advantage of a weakness of mine and induced me to put that society au courant with "my doings" in Haiti. The weakness referred to is a disinclination to say "no" when I should do so. The same fatal failing is to be blamed for my appearance here to-day. True, I felt myself much honored by Mr. Barker's kind invitation to tell you about my experiences, and it is equally true that I appreciate the opportunity to talk before such a thoroughly understanding audience. But, alas, it is likewise true that the immense labor of numbering and cataloguing my collections has encroached upon the time that should have been given to the preparation of this lecture. I should like to describe and dicuss certain interesting features of the Haitian flora, such as the occurrence of the andine-boreale element in the higher mountains of the Republic or the characteristics of the soft limestone vegetation. With what pleasure would I have described the floral wonders of the high La Hotte or the highly xerophile thorn-thickets of the northwestern peninsula. But to do this well would have meant careful preparation extending over many months, and I am not so sure that I could have done so with the material at hand even then. I must therefore content myself with a brief outline of my excursions and of what I have tried to do aside from that somewhat monotonous search for new genera and species. As I dare not suppose that you are all familiar with the problems which the Haitian flora presents to us botanists, I will prepare the soil for the narrative with a few words on the history of botanical exploration of the island.

Haiti, together with Jamaica, enjoys the honor of being the locus classicus for our knowledge of tropical American flora. As early as 1690, even before France was ever acknowledged officially as mistress over any part of Haiti, a pater of the Minimes, Charles Plumier, visited the island as "Botaniste du Roi." It is not on record how many souls the venerable pater saved, nor do we, in his numerous books, find any references as to the admittedly rotten morals of those days (remember the buccaneers whose guest Plumier must have been, at least when visiting Tortue), but what we do find is a wealth of artistic drawings of lovely plants accompanied by very good descriptions for those days.

Plumier's headquarters here in Haiti were Léogane and Port de Paix. From Léogane he made a number of excursions into La Salle

[1] Read at a conference of the staff of the Agricultural Department of the Haitian Government, Port au Prince, Jan. 4, 1926.

and he had the audacity to cross the main ridge on an excursion from Anse à Pitres to Fonds Parisien. Those of you who have had opportunity to make the acquaintance of that mountain and its so-called roads as they are to-day will readily appreciate the pluck of Plumier in making such a trip 235 years ago. As I have already intimated, Plumier did not collect plants as we do to-day but drew them. Each drawing was accompanied by a short description and a phrase name. Later Linnaeus and other botanists substituted these phrase names by the now valid binary names, thus making Plumier's drawings the types for their species. It then became incumbent upon collectors in these islands to rediscover the plants which Plumier had drawn, in order that they might be fully described and definitely placed. Most of these plants were readily found again but a certain number (in 1920 about 50 phanerogams and 30 ferns) remained still to be identified. Before proceeding with this interesting matter, let us recall some of those botanists who labored to rediscover those plants of Plumier. During French colonial times Haiti was visited frequently by European collectors, and the exploring activity grew gradually, until culminating shortly before the Revolution. A "galaxy of stars" as you Americans might express it, was then working assiduously in Haiti, to wit: Swartz, Louis-Claude Richard, Tussac, Nectoux, Martin, and others. Even during the bloody days of the strife for independence some botanists labored here, notably Poiteau and Descourtilz, one presumes. not without certain inconveniences. Descourtilz was even taken prisoner, his collections destroyed, and his life only saved because of his reputation as a skilled physician. During the following 80 years or so, Haiti was considered eminently "unhealthy" for botanists. Not until Professor Ign. Urban of Berlin began activities which have proved so important for the knowledge of the West Indian flora did exploration in Haiti become livelier. Professor Urban induced Père Picarda of the Séminaire Martial to make excursions in the south, and encouraged my friend, Mr. W. Buch, in his independently undertaken canvassing of the north. The results of the efforts of these botanists was the discovery of several hundreds of unknown plants and the establishing of the fact that the flora of northern Haiti was quite different from that of the south. Simultaneously. Baron Eggers. the Danish botanist, was induced to make a trip into the Santo Domingo mountains known as Cibao. Here he found a most astonishing flora, quite rich in plants not found elsewhere in the West Indies but well growing in the higher mountains of continental America, some even in Europe. Of course, I do not refer to those weeds introduced by colonial settlers in Kenskoff and Furcy, but to real bona fide wild

species. This sensational discovery put new life into the exploration of the island. I shall mention further only the names of Tuerckheim, Fuertes, Christ, Nash, and Taylor. The last two gentlemen were American botanists in the service of the New York Botanical Garden. They made Bayeux their headquarters and from there explored principally the eruptive mountains of the North. On the other hand, Mr. Buch had confined himself mostly to the dry limestone region of Gonaives.

In spite of the efforts of the botanists named, a goodly number of Plumier's plants remained hidden away somewhere. It became every day more necessary to find some one willing to hunt for these elusive species, some one who would not hesitate to follow the trail of the audacious pater, be it to the deserts of the northwestern peninsula or to the chilly heights of La Selle. It may have been observed that among the collector-botanists mentioned, only one was a Swede; namely, Swartz. This may seem the more peculiar since the Swedes had elsewhere made a good reputation for themselves as explorers. The truth is that they had for half a century or so concentrated their efforts upon Brazil, for the very good reason that they had funds provided exclusively for the exploration of that country. In 1914, it was planned to start a new expedition for Brazil. Professor Urban now prevailed upon the Royal Academy of Sciences in Stockholm to change the plans for that expedition so that a part of the money at its disposal was to be used for research work in Haiti. The botanist thus blessed with this twofold assignment happened to be myself. It became, as it usually does in such cases, a question of serving both God and Mammon, a proverbial paradox. My chief at the time, Prof. Dr. C. Lindman, had somehow arrived at the conclusion that the road from Sweden to Haiti lay over New York and Habana. I remember protesting; feebly, it is true, because I desired to see these places. I did not tarry long in New York. Only a couple of weeks in order to determine the Vernoniæ of the herbarium of the New York Botanical Garden. My sojourn in Cuba became so much the longer. On arriving at Habana I had news of the revolution in Santo Domingo, and was also informed that no steamers from Cuba were allowed to touch that island on account of some cases of bubonic plague. So I began collecting in Cuba while waiting for an opportunity to continue my journey. Then came the European war, making traveling everywhere in the world very hazardous, and furnishing me with a wonderful excuse to stay where I was. I did not waste my time while in Cuba, however. Professor Urban has pronounced my collection of Cuban plants to be the most valuable ever made in that

island, as well as by far the most extensive one. It consists of about 50,000 specimens in nearly 20,000 numbers, with approximately 1,000 new species.

However, my instructions were to go to Haiti and, while, ordinarily, I do not suffer from conscience, I did not like to think myself unworthy of the faith my supporters had placed in me. A splendid opportunity to make good came with the so-called Chambelona revolt in Cuba in 1917. This for a long time made botanical excursions in Cuba quite risky. I had also acquired a friend, Mr. J. Jensen, of Bergen, Norway, who was interested in going to Haiti to study the possibilities for bee culture there. Accordingly we started for Les Cayes in May, 1917. I still remember the vivid impression of exquisite loveliness the coast of the southern peninsula first made upon me, with its high mountains and many quaint little towns nestling in inviting nooks. These impressions became a little mixed, however, on the approach to our boat of a canoe with a couple of Haitian fishermen, wild-looking, half-naked fellows talking a language that sounded like, but most assuredly was not French. We rapidly made ourselves at home in Les Cayes, however, and I began my excursions. The plain of Les Cayes was not so very interesting, at least not for one spoiled by rich findings in the Cuban mountains. But to the north of Les Cayes towered dark green mountain masses dominated by a double-topped, pine-clad peak. I was told that La Civette, near Camp Perrin, would be a good starting place for an excursion into those mountains. Consequently I went there, walking, like the prospectors of old, leading a patient burro loaded with collecting papers and supplies. We, for Jensen also came along, had the luck to find in Batiste Jean Polonais in Civette a very good host. From Civette a steep mountain trail leads up into Jardins Coutard, on the northern slope of Morne Vandervelde. The southern slope of the mountain was not very interesting, but its northern slope abounded in rare or unknown plants. The mountainside is steep, cut up with deep ravines, and in places covered by easily loosened limestones, which combine to make traveling rather troublesome. Of course, it rained also, and the steep paths in the slippery laterite became nearly impassable. At that time this mountain plantation was fairly well populated, not by real settlers, but by the young bucks of the families living in Civette, who came up here to plant beans, malangas, bananas, etc. They do not build any houses, only so-called ajoupas, temporary shelters against the frequent rains. Toward evening we came to such an ajoupa to find shelter for the night. I had for guide an old half-witted fellow named Chou-chou, evidently afraid to stay alone with a white man and make camp with him. One glance at the

ajoupa we came to was enough; nearly a dozen men to share a little shack about 10 by 6 and all indescribably muddy from their work in the rain. I took Chou-chou back with me to a deep ravine, the Source Mare Blanche, which we had passed, and intended to stop there overnight. Chou-chou became terribly excited, claiming that the fellows we had just seen were all very bad men, and that they would throw stones upon us during the night. I had to give in to the old fool and climb high up the opposite side of the ravine to make the best out of an abandoned ajoupa we had seen there. Here we made a nice meal of a chicken I had brought along and spent the night fairly comfortably.

Next morning we climbed the mountain side to about 1,100 meters altitude, where the pines and the mountain palms begin to appear. Unfortunately, it began to rain, and continued a steady drizzling, which chilled the body to the bone. My fingers turned numb and white, and once I slipped, cutting myself on the machette, but because of the chilling bleeding was negligible. Under such conditions I had to give up all hopes of reaching the top even of the moderately high ridge above Mare Blanche.

On the way back to Civette, which we reached in the afternoon of the following day, I collected all we could possibly carry. The botanical results of this, my first mountain excursion in Haiti, were astonishingly good, about 20 species of phanerogams, new to science, including a genus *Ekmaniocharis*, a Melastomatacea, and a new fern-genus *Atalopteris*.

I have dwelt at some length upon this excursion, because it is fairly typical of all mountain excursions. Bad weather, bad roads, no comforts whatsoever, little or nothing to eat, sometimes even no water to drink. The privations are, however, as a rule compensated by rich findings, which would not be the case if one kept to the populated regions.

As was stated, I did not get very high up La Hotte on this first excursion. I had learned, though, that La Civette, well situated as it was from the botanical standpoint, was not the proper base for an intended ascent of La Hotte. Therefore I went to Port a Piment, which is further west, to try my luck from that place. This time I got considerably higher up, perhaps 1,600 meters. There I had to turn, not so much on account of bad weather as because of poor helpers. Three strapping fellows had been recruited to cut the way along the ridge through the everlasting thickets of climbing bamboo, the *Arthrostylidium haitiense*. I had told them to bring some things to eat, as I had only some cassava and tea for myself. They agreed to do so and came with baskets filled, as I supposed, with sweet potatoes and stuff like that. You may imagine my surprise when I

found out, only too late, that the fools had brought nothing but mangoes and pieces of sugar cane. Furthermore, they refused to drink the water of the Bromeliads, without which an ascent along these high ridges is nearly unthinkable. Thus it did not astonish me that they wanted to go back early on our second day out. I forced them ahead some hundreds of meters further into the pine forest, the outposts of which we had just reached the evening before. The going here was terribly difficult on account of the number of fallen giants strewn over the ground in all directions and covered with tenacious cobwebs of the *Arthrostylidium.* I have later learned that this was the result of the hurricane in 1915. My three valiant companions now united in open revolt.

Inasmuch as I had already collected as many plants as we could possibly carry, I gave in, hoping to be able to return later and complete the ascent. Botanically I had cause to be well satisfied with the trip as still another score of new species and a new genus, the *Peratanthe Ekmanii* had been collected.

It may be worth mentioning that before starting on the excursion just described I had passed through a very severe attack of malaria. That dreadful disease came upon me in an unusually treacherous way, without chills or fever, only manifesting itself in loss of appetite, vague achings in the bones, gradual loss of strength and energy. I was already so far gone as to be unable to walk before I understood what was the matter and could send Jensen to Les Cayes to get quinine. I can never fully appreciate what Jensen did for me during this long period of illness. Jensen was a wonderfully gifted man in all respects, save in that of speaking the language. Creole always remained a mystery to him. I remember the first evening we came to Port à Piment and wanted to buy some eggs. I tried to convey our wish to the lady owner of a little shop, with the result that she brought us *sugar.* Jensen laughed and I tried vainly to explain that the two words "z'eux" and "sucre" resembled each other enough to cause the mistake. Next day he insisted upon buying the eggs himself with help of my little pocket dictionary. He came back with the eggs and was very proud of himself. Only long afterwards did I learn how he got them. He had entered the little store, and uttered the single word "oeuf." As nobody understood what he meant, he repeated "oeuf," "oeuf." When even that did not seem to help, he flapped with his arms, crew like a rooster, and—got what he wanted.

On returning from this mountain excursion Jensen was fed up on Port à Piment and wanted to go back to Les Cayes. A new attack of malaria convinced even me that the time for the climbing of La Hotte had not yet arrived. From Les Cayes I tried to get

on top of the central group of La Hotte, the Tête de Boeuf, north of St. Louis du Sud. There I had the most disgustingly bad luck with the weather, and consequently had also to put this top in my list for the future. Still another attack of malaria and I grew so tired of Haiti that I returned to Cuba.

Professor Urban, however, having found about 80 new species of plants in my collections from Haiti, and arrived at the conclusion that La Hotte, floristically, was quite unique among Haitian mountains was not the man to let me pursue my peace and happiness in Cuba. He made the Stockholm people put up further funds and sent me on another trip to Haiti, this time with definite instructions to climb La Hotte. Like most human beings I dislike to do what I am told to do and so I resolved to climb all other mountains in the Republic first and then La Hotte, if ever. In order to carry out this praiseworthy undertaking I had to establish myself more centrally than before, i. e., in Port au Prince. I came here in July, 1924, on a Sunday, and on the very next day was taken to Morne à Cabrits by one of my new-found friends, Mr. H. D. Barker. We went there in the afternoon merely to see *Pseudophoenix vinifera*, a beautiful palm common there. I had no collecting papers with me, and merely grabbed a few plants off the roadside. There were two new species in this "grab," however.

This will show perhaps how much still remains to be done in Haiti. As it happened, Morne à Cabrits is part of a mountain range which Professor Urban also had recommended for closer investigation. On my next excursions there, I found quite a number of new species and no less than two genera new to Haiti, although known from Cuba. It may be a coincidence, but it is surely strange, how many Cuban genera I have found since arrival here. Admitted that during the 10 years I spent in Cuba my eyes grew keen for Cuban plants, one wonders what would I not have found had I spent 10 years in Jamaica before coming here? Or in New Zealand, or Madagascar? And is it not true that quite a lot of the subjective enters into purely objective science?

I was anxious to go to Montagne La Selle, for I know from Professor Urban's publications that many European plants occur there. These are introduced, of course, and may be weeds, most of them, but dear to one's heart, nevertheless. After 10 years in Cuba I was anxious also to see a mountain meadow resplendent with *Trifolium*, *Chrysanthemum*, *Taraxacum*, *Geranium*, *Silene*, *Brunella*, and others. Aside from this purely sentimental reason I wanted to find out if the mountain really was so thoroughly explored as Professor Urban meant, and as one would believe after all these excursions of Plumier, Richard, Martin, Nectoux, Bertero, Jaeger,

Picarda, Christ, Buch, and, more recently, Leonard. The last named had, during a stay of several months, only found a few new phanerogams in La Selle, and those mostly belonging to critical genera. Consequently, I went to Kenskoff and Furcy, kindly invited by Mr. Tippenhauer to follow him there on a survey of certain mountain roads. I spent about two months in these interesting regions, paying especial attention to the steep slopes of La Selle proper, at Morne La Visite and Morne Cabaio. The high ridge itself has been visited by Mr. Buch and Père Christ, and consequently fewer things of interest were found there. In that short time, I found not less than 40 species already recognized as new, among them a Catesbaea with flowers about half a foot long, and a new genus, *Herodotia haitiensis*, a Compositae from Morne Tranchant. Besides, I was lucky enough to find not less than four genera known from other countries but new to Haiti, the peculiar Umbellatae, *Spananthe paniculata*, the strange-looking Loasacea, *Sclerothrix fasciculata*, and two introduced but now fully established European genera, *Sherardia* and *Scorzonera*. At that, my collections from these excursions are only in part determined; several other species may be recognized as new. Not a bad showing for two months' work in this supposedly well-explored region.

Among other plants of interest found here are quite a number of those continental plants discovered by Eggers in Cibao. This proves, at least, that the distribution factor to which we owe the peculiar flora of Cibao also played a rôle in the development of the Haitian mountains. So much more remarkable is the lack of this characteristic floral element in La Hotte, where appropriate conditions are at hand in many localities.

Many as were the interesting plants found, none proved to be identical with the lost plants of Plumier. Evidently Plumier had never done what is so frequently done to-day, that is, hired a horse in Pétionville and gone visiting in Kenskoff and Furcy. But he mentions frequently a certain Fond de Baudin, and quite a few of his plants were found there. Everybody assured me that this Fond de Baudin must be the Fond de Boudin of to-day; that is, the Trouin valley, on the road to Jacmel. Mr. Barker was kind enough to take me there, and we really had the pleasure of rediscovering two of the plants in question, not to mention a new genus of Melastomaceæ, *Mommsenia aplevra* Urban et Ekman. But there should have been several other plants, among them a Bromeliad, *Vriesia paniculata*, which could not possibly have disappeared, since it grows in steep cliffs, and is readily recognized even from far off. These plants I did not find, and hence I am inclined to believe that

the Fond de Boudin is not the Fond de Baudin. I now think that this valley was somwhere in the L'Argent Commissaire mountains, on the road to Jacmel from Rivière Froide.

Naturally I was curious to see something of the flora of northern Haiti and a splendid opportunity to go there was offered me by Jenkins and Gray, working for the Department of Agriculture in connection with the rubber plantation at Bayeux. On the road to Bayeux, these gentlemen were kind enough to give me time to climb the 1,500 meters high Morne Basile of the Cahos massive. This was my first acquaintance with a flora of a type quite distinct from that of all southern mountains. The geological structure of this mountain is similar to that of many others in Haiti, a cap of hard eocene limestone on a base of eruptives. The lower slopes of the mountain had little of interest to offer. The limestone cap, however, is covered by a virgin forest very rich in rare or new species. Two genera new to Haiti were found here, Plinia and Schlegelia, and a number of new species. As my good luck would have it, there is another more conveniently situated mountain near Bayeux of exactly the same type, namely Morne Brigand, only that here the limestone reaches further down, even to sea level. Mountains of this type are as a rule nearly inaccessible, the rocks being rough and steep, full of clefts and caves. I well understand why my honored predecessors in this region, Poiteau, Buch, Nash, and Taylor have found so few or practically none of the plants characteristic for this type of mountain although well exploring the eruptive mountains of the Maleuvre type. It would take us too far to mention simply the new trees found here. Furthermore most of the plants collected here are still awaiting determination. I can not avoid, however, telling a little about "Tavernon montagne," a gigantic representative of the Leguminosae, easily the biggest of all indigenous Haitian trees (the Mapou is introduced). I found it sterile at first, then in fruit on Morne Maleuvre. It was easy for me to recognize the genus as new or at least not known from the West Indies. But flowers were needed and I am not going to tire you by telling about how many excursions I had to make before I found them or how many trees I climbed in vain. At last in November of last year in Haut Piton, near Port de Paix, I got what I wanted.

Another plant of extreme interest found in these mountains is the *Cymbocarpa refracta*, a white-flowered, pale yellow saprophyte representing the Burmanniaceæ, a family now found for the first time in Haiti. Still another is the unbelievable *Pterocissus mirabilis*, a new genus. It must be seen rather than described in order to be appreciated.

We have now advanced as far as the end of 1924. Professor Urban had for some time been goading me with requests for plants to study and to please the grand old man I went back to Port au Prince, labeled and numbered my collections and sent them away. He has written me since telling me that there were in all about 100 new species in the remittance, and kindly characterizing it as "überraschend" and "prachtvoll."

The first excursion of importance during 1925 was the ascent of Morne La Selle. I have already mentioned that the high ridge of the mountain had been visited by Plumier, Christ, and even repeatedly by Mr. Buch. None of these gentlemen, however, went up higher than 2,200 meters, and no botanist had ever tried to reach the top itself. This seemed very puzzling, as judging from the nature of the mountain, there should be no difficulty whatsoever in reaching the top. Mr. Buch told me, however, that he had tried to get up there but had been turned back by the natives in a little place called Badeau, and that Mr. Tippenhauer had had the same experience. None the less this Badeau or the place close to it, Camp Franc, seemed to be the right place for the attempted ascent. I went there over Bassin Général, Morne Dumée, Trou Coucou, Chapelle Mare Minerve, Boucan Greffin. Camp Franc is situated on the ridge between the two branches of Rivière Blanche. East of it, on the other side of a deep gorge, is Badeau. Even in the immediate vicinity of Camp Franc many interesting plants were found, among them the beautiful *Selleophytum Buchii*, resembling the Rudbeckias of the United States. A road from Camp Franc leads over the high ridge of La Selle to Saltrou. I followed it for some 4 miles, turned back, followed a narrow trail toward some high parts of the ridge, and came out into the open above Badeau. To the east I saw what I then thought was the highest point of La Selle (and what was evidently considered as such by Buch and Tippenhauer). A deep ravine separated me from my goal, so I decided to go round it and in doing so came into *Arthrostylidium* thickets and was consequently stopped very effectively. I was mighty glad to come to Badeau about noon next day, nearly dead of thirst. That this could happen to me, a lone Swede in a strange country, is not astonishing, since the same thing happened repeatedly to whole companies of colonial soldiers chasing renegade slaves in these mountains. These soldiers, according to Moreau de Saint-Méry, even tried to drink their own urine. Thank God I did not have to go that far, although I tried to moisten my burning lips with mosses and moist soil.

However, I had located a nice open ridge which carried straight up toward the top I had seen. I returned to this place two days

later, now carrying a little calabash with water in addition to what I had in my canteen. You may wonder perhaps why I did not get water from the Bromeliads here as in La Hotte. The answer is evident—there are no Bromeliads to be had on these open or pine-covered ridges of high La Selle. *Tillandsia hotteana* and *Thecopyhllum sintenisii* occur, but only high up in the pines where one can not get them. The ridge in question begins at the highest spring of Badeau. I climbed steadily upward, found a few interesting plants, ate strawberries, and on the whole, had a nice time. I was now nearing the top, when to my astonishment I saw *two men on horseback* passing a little higher up. I cried out to them and they waited for me to catch up. To my question they informed me that the top where we were was Morne Emérillon and that the road led from Emérillon to Saltrou. This road is no doubt the highest in the West Indies, passing the ridge of La Selle at 2,400 meters altitude. However, this was far from being the highest part of La Selle as I was soon to learn. From the top of Morne Emérillon I could see a whole series of tops, all higher than the one on which I stood, extending toward the east. The whole day I traveled eastward, through high pine forest, over limestone ridges covered with loose stones of macadam size, nearly free from vegetation. Here I found among other interesting things a trailing juniper not over 1 foot high forming vast colonies. At last, at sunset, I stood on the highest point of La Selle. It was now too late to make any observations so I had to sleep on top of the mountain. Early in the day I had the misfortune to slip and lose my precious calabash with water. Hence there was little to drink and only four small biscuits to eat. In addition it was bitterly cold and, as usual, I carried no blanket. Luckily. there was pine in abundance and I slept nicely with a roaring pine fire on each side.

I had expected a nice view from the top next morning and was not disappointed. Bathed in the early rays of the sun lay the great Cul de Sac Plain at my feet, with the Etang Saumâtre straight north and Enriquillo northeast. Behind the long Chaîne des Matheux stretching from St. Marc to Neyba towered the high peaks of Santo Domingo and central Haiti. Loma Rosilla and its sister mountain, Pico del Yaque, easily dominated all mountains in Santo Domingo. I strained my eyes to find that famous Monte Tina, everywhere considered as the highest mountain of the West Indies, but saw no mountain anywhere which could possibly compete with Loma Rosilla in altitude.

As to the altitude of La Selle itself, where I stood my barometer indicated 2,540 meters, which, with the necessary correction of 10 per cent would give the altitude of 2,794 meters. This is 100 meters

more than generally conceded the mountain. The sea chart of the Eagle expedition, however, gives the altitude as 9,186 feet which is nearly exactly 2,800 meters.

The vegetation of the top itself is poor. Besides the ever present pine and agave I noted only Garrya, *Eupatorium illitum*, Pteridium, *Pilea lanceolata* and *P. microphylla v. succulenta*, Bocconia, *Seenecio buchii*, *Salvia selleana*, *Baccharis myrsinites*, *Gnaphalium domingense*, and *Danthonia domingensis*. But on a somewhat lower top to the north I collected a beautiful new *Salvia* in abundance, also a new *Baccharis*, and in a shady place on the slope of the top a *Ranunculus* and an *Erigeron*, both probably known from Santo Domingo.

I knew, of course, that the top had been climbed before and found ample evidence of this in felled pines, rusting tin cans, etc. To clinch the matter I found on a rock a brass plate with the following inscription: "Levée de la République d'Haiti, Département des Travaux Publics, par la U. S. Geological Survey. Elévation au dessus de la mer (in blank) mètres. La loi punit sévèrement toute dépredation et le déplacement de cette borne."

I had scarcely rested up from this tiresome trip before I received an invitation from Messrs. Sweet and Kocher to be their guest for some time in their camp in Christophe's Palace on Crête à Pierrot, near Petite Riviere de l'Artibonite. From here I explored the tidewater flats near Grande Saline, where I found *Suaeda*, a genus new to Haiti; the swamps of Estere, which gave me *Luziola*, another genus new to the island; the steep and sterile limestone hills between Mapou and Dessalines, where I located *Auerodendron* and two other genera new to Haiti and possibly to science; and, last but not least, the Grand Cahos. As companion on this last trip I had a mule whose eccentricities perhaps are worth mentioning. This animal behaved nicely as long as I rode—that is, between Petite Riviere and La Source, on the way to Médor. There the road became too steep for riding and I had to lead the animal. To say that I led the mule is not correct; I mean I had to drag him. When I tried to get behind and freshen the beast up a little he kicked at me and threw the load. Besides, he wanted to turn off the road into every little side path he could locate. I came to Médor, however, most beautifully situated in a wild mountain country, and next day to Perodin, where I intended to stay for a couple of days. Here the mule was tied to a tree and left to eat. Next morning he had disappeared, but was found again after a couple of hours. The thing was repeated next day, only he now managed to stay away nearly the whole day. By now everybody was aware of his little trick; he just bit off his tether rope. He was then put into an empty room of the gendarmerie barracks and there I found him upon my return from the highest mountain in the group, the Morne Nan-Plaine, 1,725

meters. I was to go back to Perodin the following morning, and rejoiced at the thought that the mule would be there ready for me. When I came to get him, however, the room was empty and the prisoner gone. He had managed to open the door and get out, and nobody had seen him or knew where he was. Toward evening I got tired of looking for him, found, after much trouble, a horse, and started toward Perodin. No doubt this beast knew the road and hated it, as I could not possibly make him pass a certain difficult place. When I was ready to commit murder and suicide, a little boy appeared and told me that my precious mule had been located high up on a mountain side peacefully eating sweet potato vines at the rate of "1 gourde" per hour. There I found him all right the next day and brought him to Perodin and from there to Petite Riviere, carefully avoiding leaving him alone for a moment. With many thanks I delivered him, plus 15 gourdes, to the gendarmerie where he belonged. On relating my adventures to the captain, he wanted to have a look at the monster. We were too late; he had already chewed off his rope and disappeared—I hope forever.

To return to botany again, the vegetation of the Grand Cahos is interesting, maybe not so much on account of the new species found there as on account of the composition of the flora. The eruptive slopes of the mountain have a vegetation identical with that of the northern mountains and its limestone cap, the flora of the south at corresponding altitude. This is peculiar, in as much as the other high top of the Cahos massive, the Morne Basile, only some 200 meters lower, is typically northern as to its vegetation.

I have mentioned earlier that Plumier had his headquarters in Léogane and Port de Paix and that, accordingly, the plants he found were apt to be rediscovered somewhere near these places. Now Mr. Buch has a life-long friend in Port de Paix, Mr. Charles Abegg, the American consul of the town. Mr. Abegg had kindly invited me to come there, and from April to November last year I explored northern Haiti thoroughly. It would take altogether too much time to follow all my excursions there in detail. Suffice it to say that I climbed all prominent mountains between Trois Rivieres and the sea, both those belonging to the eruptive chain and those of the coastal limestone chain. Not less than four times did I ascend the Haut Piton, 1,205 meters, a most prominent landmark of the Port de Paix region. I also searched the Gros Morne mountains for their hidden treasures and suffered hunger and thirst in the terrible quaternary limestone regions of the Môle St. Nicolas. Particularly in this region did I find the most interesting plants, not less than six genera new to Haiti, some even to science. Here certain Cuban plants appear, not very many perhaps but interesting

anyway, as the genera represented are known only from western Cuba so far. In Ile La Tortue, which was also visited, still another floral element sets in, the Bahama vegetation, likewise only feebly accentuated. I stayed in Tortue long enough to make a little flora of the island. According to my notes there are 750 phanerogams, of which 178 are trees and 106 shrubs. Endemic plants are few, maybe 15, which number may be reduced when exact determinations are at hand.

Everybody who has done any traveling in Haiti must have observed how insufficient, not to say incorrect, all existing maps of the country are. Even the best, that of Thomasset and Poujol, is, so far as the mountain regions are concerned, entirely wrong. The few correct altitudes given are mostly copied from Moreau de St. Mery. Not a single mountain is correctly located, even prominent rivers such as Rivière Barre in the north and La Ravine in the south are wrongly drawn. In a word, the whole map is a fake. This is the more difficult to excuse as there exists a beautiful set of sea charts, those of the Eagle expedition, correct as to the coastline and as to mountain tops clearly visible from the sea, which could easily have been used in making a fairly good map of Haiti. To find out about this possibility I have drawn a map of the country between Trois Rivieres and the sea, using only a sight compass and my barometer, and I dare say that this is the only fairly correct map of any mountain region in Haiti made to date.

On my return to Port au Prince from Port de Paix I made up my mind to number and send away all collections brought together during the year, about 8,000 specimens in some 2,000 numbers. But one can never tell. Mr. Barker asked me if I could not be induced to leave off work for a while and go with him on an excursion into La Hotte. This was too good to be rejected, although by rights the time for the final La Hotte effort was not yet arrived. Most of you have doubtless heard about this excursion from Mr. Barker himself, so I shall not go into details. We did not reach the top on account of disgusting weather and likewise disgusting vegetation. But we learned enough about the country to know where to start next time. The floristical results were as good as they could be under the circumstances. I even had the pleasure of finding a species of *Tapura* here, belonging to a family not before recorded from Haiti. A most curious Vacciniacea may be a new genus as may also a very peculiar Piperacea. No continental plants were found on this excursion, just as none were found on my earlier excursions in La Hotte.

We botanists are sometimes asked and, indeed, quite often, by persons who ought to know better: "What's the use of it all?" The question is rarely met with in Haiti, as they take for granted that we

are looking for medicines. I can not forget how, after my so-called conference in the Société d'Histoire et de Géographie, I was fairly drenched with questions whether this or that drug plant was to be found in Haiti. It was soon evident that in my audience there were only three men who really appreciated the work done: Doctor Payne, Mr. Buch, and Mr. Tippenhauer. In other countries, however, "publicum" thinks itself more enlightened and it is there we often are made to answer that impertinent question. It would be perfectly useless to try to explain that we take all our pains for the sake of knowledge itself as our interrogators generally belong to the class of people who think that they know it all. If in a cynical mood, I meet the question with the answer that I do what I do because it pleases me, or else I make it clear that my work has its value for the so-called "Kultur defense" of a small country like Sweden. If a scientist should ask me anything, he would put the question: "In what way has science profited by your work?" I would then proudly tell him about how many new species and new genera I have found, and I would also explain how much botanical research work in Haiti contributes to our understanding of the development of plant life in the West Indies.

THE SUPPLY TABLE OF THE MEDICAL DEPARTMENT, UNITED STATES NAVY

By A. B. Montgomery, Chief Pharmacist, United States Navy

With the adoption of the Supply Table of the Medical Department, United States Navy, 1926, on July 1, 1926, and because of the radical departures from some of the principles that have been applicable to Supply Tables of the Medical Department, United States Navy, for more than 100 years, it is fitting that a discussion of the reasons for and of what it is hoped may be accomplished by these departures from "established customs" should be made at this time.

The earliest available record of instructions as to the source and accountability of medical supplies for naval medical officers is that issued for the British Navy and contained in "Regulations and Instructions Relating to His Majesty's Service at Sea," printed in the year 1772. It may be of interest for the reader to make comparisons with these instructions and those that have been effective with our Supply Tables, so the following articles, with reference to "The Surgeon," are quoted:

> He is to examine the Necessaries sent on Board for the Use of the Sick Men, and if they are not good in their Kind, to acquaint the Captain, that he may Present the Matter to the Navy Board. He is to keep the said Necessaries in his Custody, and not embezzle or misapply any Part thereof, but take Care

that they be well husbanded, and duly served out for the Relief of the Sick Men.

The Master and Wardens of the Company of Apothecaries, having frequently made Representations of the Proceedings of Some of the Surgeons of His Majesty's Ships, with regard to the Providing and Recruiting their Chests; and it being of great Consequence to the Lives of the Seamen, to have the utmost Care taken that the Medicines should be as good as possible; every Commander of His Majesty's Ships and Vessels is strictly charged to take Care that the following Regulations (as well as all other Directions contained in the General printed Instructions relating to the Surgeons) be punctually complied with.

When a Surgeon is warranted to served in any of His Majesty's Ships, he is to immediately provide himself with a Chest of Medicines from the Company of Apothecaries, and with proper Instruments, according to the Rules of the Navy; and present the same to be viewed by the Physicians in the Commission of the Sick and Wounded; or if there be none, by the Physician of Greenwich Hospital, in Conjunction with the Governors of the Surgeons Company; who are to take Care, that all the Instruments, Drugs, and Medicines, be of proper Goodness, and of the Sorts and Quantity required, and to give him a Certificate thereof; and when the Survey is over, the Chest to be locked, and the Seals of the Physicians, and of the Surgeons Company, to be affixed thereto, in such Manner as to prevent its being afterwards opened, till it comes on Board; nor is the Captain to admit any Chest into the Ship, but what has been taken from the Company of Apothecaries, and having those Marks upon it.

At the end of every six Months, if the Ship is in Great Britain, or as soon after she returns thither, the Surgeon is to recruit his Chest from the Apothecaries Company; and he is also to do the like whenever the Ship is ordered upon Foreign Service: And he is not to be paid his Wages or Two-pence without his producing a Certificate from the Master and Wardens of that Company, that he has taken his Medicines from them, or that they have no objection to his being paid such Wages and Two-pences.

It appearing by the Reports of Experiments made of Dr James's Fever Powders on Board His Majesty's Ships, that it is a very efficacious Medicine for curing Fevers at Sea; and it having thereupon been thought proper that the said Powders should be supplied by the Commissioners for Sick and Hurt Seaman, to all His Majesty's Ships and Vessels put into Commission, in the following Proportion.

Number of Papers for six Months for one Hundred Men, and so in Proportion for the Complement of a Ship or Sloop of War employed at the places undermentioned.

	Channel.	Newfoundland, Lisbon, or Mediterranean.	Coast of Africa, and West Indies.
No. of Papers	25	50	75

Their Commanders are accordingly to apply to the said Commissioners for a Number of Papers to be furnished to their Surgeons, agreeable to the said Proportion: And proper Quantities of the said Powders being directed to be lodged in the Hands of the Agents to the said Commissioners, both at Home and Abroad, for supplying the Surgeons of His Majesty's Ships with what may

be wanted, after their first Fitting out, upon a Demand in Writing signed by the Captain; and it being judged proper, that when such Demand shall be made, the Surgeons shall at the Time transmit to the Commissioners for Sick and Hurt (if in Home Service) or to their Agent, (if Abroad) a perfect and distinct Account, verified by their Affidavit, of the Expenditure of the Powders they were before furnished with, together with the Name of each Person to whom they administered the same, to secure the Crown from any Fraud or Embezzlement; the Captain is to take Care, when the said Demand is made, that the Surgeon sends therewith such an Account and Affidavit as is above specified. And the Captain is strictly charged to enjoin his Surgeon to administer the said Powders in all Cases for which it is recommended by Dr. James, and in the Manner advised by him, of which you are to be informed by the Commissioners for Sick and Hurt; and to see, as far as shall be able, that the same be complied with.

The earliest history of the Supply Table of the Medical Department, United States Navy, available, is contained in "Rules, Regulations, and Instructions for the Naval Service of the United States, 1818."[1] The tables published therein list the items of medical department material in classes, medicines, fumigating articles, instruments, etc., stationery, hospital stores, hospital utensils, bedding, and cockpit furniture. The tables are referred to as "Estimate F," and specify a definite allowance of each item for the various type vessels in units of number, pounds, ounces, and drams. The accompanying instructions state:

It is, however, to be understood, that the first supply shall be considered sufficient for one year, unless there shall have been an unusual prevalence of disease among the crew. This circumstance, moreover, shall be certified, and the certificate forwarded to the medical purveyor, as a voucher for deviating from the established rules of the service.

The supplies were obtained and delivered to the surgeon of a vessel by the medical purveyor of the port and all reports and returns of medical department property were made to him; he, in turn, accounting directly to the fourth auditor for the Treasury. Any losses that could not reasonably be accounted for were deducted from the pay of the surgeon and his assistants. The medical purveyor continued to furnish the medical supplies until the establishment of the Naval

[1] The supply table of the year 1818 is apparently the result of recommendations contained in "A treatise containing a plan for the internal organization and government of marine hospitals in the United States, together with a scheme for amending and systematizing the Medical Department of the Navy," by Surg. William P. C. Barton, U. S. Navy (later appointed First Chief of Bureau of Medicine and Surgery and served from Sept. 2, 1842, until Apr. 1, 1844), published in the year 1814. It was proposed therein that a "board of medical commissioners" be created, to be composed of six or eight of the senior surgeons of the Navy, of known ability, that should establish proportions of the medicines, dietetic articles, instruments, and utensils necessary for the different vessels. Suggested tables of proportions were furnished to be used until such a board was organized. These tables of proportions were allowances for the different type vessels and it was intended that these proposals, if adopted, would correct abuses of the service and make for economy, as is also the aim and object of the present revision of the supply table.

Laboratory at New York, N. Y., which was the outgrowth of an activity originated at the Naval Hospital, New York, N. Y., for the preparation of pharmaceutical products solely for that hospital, which was gradually extended to the supply of all hospitals of the service. By congressional authority in 1853, a fairly complete equipment was installed for the manufacture of the majority of supply table preparations. (Passed Asst. Surg. E. R. Squibb, United States Navy, was attached to this laboratory from October 21, 1853, to September 1, 1857, when he resigned to enter the commercial world and founded the well-known establishment now operated under his name.) The Naval Laboratory was the forerunner of our present Naval Medical Supply Depot, as, on May 26, 1905, the Secretary of the Navy authorized the Bureau of Medicine and Surgery to change the titles of the Naval Laboratory and the medical and surgical storehouses to "Naval Medical Supply Depot."

The Supply Table for the Medical Department, published as a part of "Instructions for the Government of the Medical Officers, 1857," was known as "Form A," and differs from the Supply Table of 1818 only by the addition or deletion of items, and the allowance tables being according to complement. At this time supplies were obtained from the Naval Laboratory, New York, N. Y., on Requisition Form B.

Later supply tables, published in 1863, 1864, 1867, 1873, and 1878, show very few changes from that of 1818. In 1881 a supplementary supply table that listed only pills and fluid extracts, with a posological table, was published as part of the supply table. Those items of the supplementary supply table were obtained by special requisition.

And so, from the earliest available record of our supply table, that of the year 1818, to the supply table of 1922, there has been very little departure in form or principle. Items have been added and deleted, though quite a few of the items listed in 1818 are still listed as items of the Supply Table, 1926. This might lead one to believe there should be no departure from principles that have operated satisfactorily for all these years and have been able to meet the progress of the Navy by only the addition or deletion of items, but modern business methods adopted to meet the requirements of other Government departments, and a study of naval medical logistics, show that a change is necessary, and, with the change from the Ninth to the Tenth Revision of the United States Pharmacopœia in which the name and preparation of certain drugs are changed, the bureau decided that a supply table must be issued that will conform as nearly as possible with present-day requirements. All changes from "the established rules of the service" have been carefully considered over quite a period of time by officers of the Bureau of Medi-

cine and Surgery with the cooperation of officers of the Naval Medical Supply Depot, Brooklyn, N. Y., and the Naval Medical School, and supported by data collected from all medical department activities of the service.

The first consideration was the preparation of a supply table in conjunction with other Government departments, that the requirements for all services might be combined for procurement, especially in the event of a national emergency. This has been carried out to a certain extent by adopting a common nomenclature wherever possible. The official English name of the "U. S. Pharmacopœia, X," has been used for all official drugs and preparations; the commercial package nearest to the size that would meet the requirements of the service has been adopted as a unit; the further use of United States Government Master Specifications wherever possible has been attempted.

The next consideration was the "balancing" of the stock of medical-department activities to conform to the actual needs of the activity instead of conforming to the allowances of a supply table.

Analyses of the "Reports of annual expenditures and stock on hand," submitted by ships, stations, and hospitals, show that the stock on hand at the majority of medical department activities is out of proportion to the expenditures. This may be due to a certain extent to the use of supply-table allowances as a guide in establishing the quantity to be carried and these allowances have been confusing to many. Some considered that the allowance was the minimum stock to be carried; others, that it was the amount to be used in six months; others, that it was the maximum to be carried; while others, that it was the maximum that could be obtained on one requisition without reference to the bureau, regardless of the stock then on hand. One activity, in requiring for an item during the fiscal year 1925, notes that the allowance for that item is 192 units, that there are 110 units on hand, and that 78 units are required, but a short time later, as of June 30, 1925, reports 306 units of the item on hand and 64 units used during the fiscal year. Another activity, in requiring for the same item during the same period, notes the allowance as 185 units, 195 units on hand, and that 40 units are required, but later reports 310 units of the item on hand and that none were used during the year. The item in the above instances was an article subject to deterioration.

Though specified that the allowances of the Supply Table, 1818, were considered sufficient for one year, there is no further mention in any of the succeeding supply tables as to the period for which the allowances are intended. The allowances of the Supply Table, 1818, are practically the same for certain items as the allowances of the Supply Table, 1922.

It will be noted that the Supply Table, 1926, does not list allowances for items, and activities must be guided by their requirements as determined by past expenditures and the " Tables of average rate of use " that are published as part of the supply table. With the extension of the " budget system " to all medical department activities, the stock will be limited to a certain extent, but not with the intention of placing any restrictions or limits on any items that may be considered necessary for the proper care of the sick, and it is believed the medical officer will be better able to exercise his therapeutic preferences without a specified allowance for each particular item. The estimates of requirements for the fiscal year submitted by activities are no doubt based on past expenditures that will also serve as a guide in the preparation of requisitions and determine the stock to be carried.

As stated in Bureau of Medicine and Surgery's Circular Letter No. 427–1926, dated April 26, 1926, the stock of Equipment (non-expendable items) should be considered as that on hand July 1, 1926, but the stock of Supplies (expendable items) must be determined by each activity with very careful consideration of all the factors that may influence the requirements. The stock should include a sufficient quantity of those items necessary to maintain the activity with due regard to the service on which engaged, and might be called the " working stock," but in the case of those items of Supplies that are not designated by the letter (p) an additional stock of six months' supply for ships and stations within the continental limits of the United States and one year's supply for hospitals, hospital ships, and outlying stations should be included. This stock will constitute a reserve in the event of an emergency, or the minimum stock to be carried, but should not be set aside to deteriorate, and should be included in the working stock for use. It could be maintained by specifying a " low limit " in the stock of those items that would constitute this minimum stock in that the working stock would be replenished when this low limit was reached by use.

An attempt was made in the bureau to establish a definite low limit of stock for each activity, according to type, by an analysis of the " Reports of annual expenditures and stock on hand " as submitted by the medical department activities of the service, but this was found to be impracticable because of the variations in rate of use between ships of the same type and complement, stations of the same complement, and hospitals with practically the same daily average of patients. It is logical to assume that a battleship with an average complement of 1,546 would use more acetylsalicylic acid in a year than one with an average complement of 1,115 that used 60 bottles, but the one with the greater complement used 25 bottles, while an-

other with an average complement of 1,540 used 66 bottles. One cruiser with an average complement of 468 used 7 bottles in a year, while another cruiser of the same type, with an average complement of 436, used 32 bottles. One group of 10 destroyers used 27 bottles of the same item, while another group of 10 used 15 bottles. One hospital with a daily average of 389.7 patients used 660 glass intramuscular syringes, while another hospital with a daily average of 455.7 patients used 491, and the hospital using the greater number of syringes used 2,224 needles for these syringes and the other used 3,105 needles. One hospital with a daily average of 307.7 patients used 524 jars of soft soap (approximately one long ton), while another hospital with a daily average of 303.6 patients used 34 jars. One hospital with a daily average of 370.6 patients used 106,050 yards of gauze, while one with a daily average of 455.7 patients used only 105,675 yards. In connection with this last comparison the hospital using the greater quantity of gauze reports a total of 699 operations for the year, while the other hospital reports a total of 1,213 operations for the same period.

The above are only a few instances that tend to show the impracticability of establishing arbitrary allowances to govern the rate of use for activities, either by type, complement, or daily average of patients, as it could only be an arbitrary allowance. So it must be the task of the activity concerned to specify the stock to be carried in order to comply with the bureau's instructions.

The "Tables of average rate of use" have been compiled from reports of activities that include a total personnel of 45,246 afloat and a daily average of 3,571 patients in hospital, and should show a fairly accurate average rate of use for the service as a whole. The use of these tables in computing the reserve stock, and with the accompanying instructions, should present no difficulties in determining the quantity per item; however, in the cases of navy-yard dispensaries and other activities where the requirements can not be reckoned in service personnel alone, additional supplies will be required that can only be determined by past expenditures. It is believed that the average rate of use will better meet the general requirements of the service than the records of past expenditures alone, in that the past expenditures may represent the preferences of an individual medical officer for certain items in the treatment of the sick and may show the use of a large quantity of these items as compared with practically none of other items, the use of which may be the preference of the medical officer who relieves him at that station.

The "Reports of annual expenditures and stock on hand" also show variations in the stock carried at the time of reports between

activities of the same type, and, of more importance, is the relation of the stock carried to the annual expenditures. Of seven battleships, each using one bottle of bichloride of mercury, the individual stocks of these ships for this item varies from 20 to 57 bottles; the combined stock of this item carried by these ships being more than twice the quantity expended by all the forces afloat in a year.

Similar instances as related above can be found for the majority of items of the supply table in the cases of the majority of activities, and this "dead" stock, scattered about in so many storerooms in all parts of the world, represents a vast amount of money that could be used for other purposes. No doubt a civilian in business, when confronted with like conditions, would take measures to reduce this surplus or "dead" stock by some inviting inducement to customers to take it off his hands, even though it would mean a financial loss at the time, or there would be a return on the actual cash received that would offset any loss on the sales. These same measures are not practicable for the Bureau of Medicine and Surgery, but measures can be taken by all members of the medical department to assist the bureau in the economic disposition of this "dead" stock which should be apparent to all. A consideration of the rate of use and the quantity on hand when requiring for items, and a disregard of the desire to prepare for an emergency other than to carry that stock as specified, in time will result in a "balanced" stock. It may also be possible to use some of these items in which an excess is carried in the place of other items in which there is no excess. Many items have fallen into disuse altogether and the disposition of the excess in these items will present some difficulty. Many of them have been deleted from the supply table, 1926, as, in the opinion of the bureau, it will be more economical to make direct purchase for the activity that *must have these items* rather than maintain a stock of these items in the medical supply depots.

This excess stock as carried by the activity concerned with their use is further reflected in the stock of the medical supply depots. The continual requiring for items by the activities regardless of the rate of use has obliged the medical supply depots to maintain a stock to meet these demands. An idea may be obtained of what this means by quoting a few instances from an inventory of the Naval Medical Supply Depot, Brooklyn, N. Y.

"Cinchonæ, tincture composita, 500 cc. in bottle; 16,339 bottles on hand, at $0.79 per bottle." (Approximately 125 years' supply at current rate of use.)

"Hydrargyri succinimidum, 0.013 gm. (hypodermic tablets, 20 in tube); 56,469 tubes on hand, at $0.04 per tube." (Approximately 124 years' supply at current rate of use.)

"Quininæ chlorhydrosulph., 0.065 gm. (hypodermic tablets, 20 in tube); 58,724 tubes on hand, at $0.12 per tube." (Approximately 793 years' supply at current rate of use.)

At some activities, this excess stock is a war heritage, but at many activities it is due to a misunderstanding of the application of the allowances of the supply table. In many instances, however, it is apparent that the accumulation is due to a desire to prepare for an emergency that did not occur, by a misstatement of the quantity on hand in the preparation of requisitions, and, without a doubt, "Form B shopping" can also be held accountable in some instances. Who is it, that has not returned from a shopping trip with a collection of purchases, and after looking over the articles, asked himself, "Why did I buy this?" Sometimes the only reason he can give is that he saw it and thought he might be able to use it some day. This same thing can apply in the preparation of Form B requisitions that have been in use for so many years but which were superseded by the new Requisition Form 4 as of July 1, 1926.

All are familiar with the economy program of the Government which must necessarily extend to every department. The Bureau of Medicine and Surgery must do its share which can only be done with the cooperation of its entire personnel. It is with this particular end in view that the above-mentioned departures from "the established rules of the service" as applicable to supply tables and the allowance tables, which were in effect in the British Navy before we had a United States Navy, were made.

The "Reports of annual expenditures and stock on hand" have been very enlightening as to conditions in which economy may be effected. They have shown not only the excess stock on hand and the normal rate of use, but also what appears to be an excessive rate of use in many instances, as will be seen by the following:

One hospital used 600 bottles of glacial acetic acid in a year.

One hospital used 168 bottles of cocaine hydrochloride in a year.

One hospital used 691 bottles of glycerin in a year.

One hospital used 408 pounds of petrolatum in a year.

One hospital used 250 bottles of procaine (also 168 bottles of cocaine) in a year.

One hospital used 655 pounds of castile soap in a year.

One hospital used approximately one long ton of soft soap in a year.

One hospital used 240 bottles of medicinal turpentine in a year.

One hospital used 115 bottles of Blaud's pills in a year.

One hospital used 660 glass intramuscular syringes in a year.

One hospital used 3,105 hypodermic needles in a year.

One hospital used an average of 290.54 yards of gauze per day with a daily average of 370.6 patients for the year and reported 342 major and 357 minor operations during the year.

One hospital used 437 drainage tubes and reports 87 major and 300 minor operations during the year.

One hospital used 54 glass funnels.

One hospital used 250 glass beakers.

One hospital used 192 glass graduates in a year.

One hospital used 1,278 glass ointment pots in a year.

One hospital used 387 balls of twine in a year.

One hospital used 120 bundles of wooden applicators in a year.

One hospital used 90 hand atomizers in a year.

One hospital used 214 hot-water bags in a year.

One hospital used 114 ice caps in a year.

One hospital used 143 dust brushes in a year.

One hospital used 344 nail brushes in a year.

One hospital used 1,132 medicine glasses in a year.

One hospital used 825 clinical thermometers in a year.

One hospital used 2,300 yards of crash toweling in a year.

The above quantities appear excessive in comparison with the reported expenditures of other hospitals, with due regard to the daily average of patients and operations during the period. They are only a few of many that could be cited, and not alone are these apparent excessive expenditures found in the reports from hospitals, but from ships and stations as well. One is led to presume that the items may be used for other purposes than those for which they are intended, a correction of which would make for economy.

Attention is invited to an article published in the Hospital Corps Quarterly for July and October, 1925, "Waste not, want not!" by C. A. Setterstrom, chief pharmacist, United States Navy, which contains many suggestions to further economy in the use of medical department supplies.

The conditions now prevailing as regards medical department material may be corrected to a certain extent with the use of the Supply Table, 1926, but much depends on the cooperation of those that use and account for this material. It is obvious that some change from the principles of preceding supply tables was necessary, and it is realized that many improvements can and will be made in this step in the right direction. Many will look at it and say, "Some more clerical work to add to our burden," for in the preparation of a requisition the stock number, name, unit, quantity on hand, and quantity required will have to be typewritten on the form (not so easy as Form B), and the estimated value will have to be computed in dollars and cents, but, if you remember the clerical work of the

British surgeon in 1772 (who had no typewriter) to obtain and account for his James's Powders, it will not seem such a task. The medical officer of our early Navy also had his troubles, as the following paragraph quoted from Instructions to Medical Officers of the United States Navy, 1867, will show. "The senior medical officer present will make out all his own receipts, returns, &c., and not delegate that important duty to any subordinates, beyond the preparation of fair copies."

No one can deny that the clerical work of the medical department has not increased, but in order to comply with recently enacted laws, to cooperate with other departments of the Goverment, and to further the reliability of statistics, this increase has been necessary. It may be the opinion of some that too many blank forms are in use; that is, too many "yes and no" returns which tend to take away the initiative of the individual in the formulation of his reports and returns, but in the compilation of the required data it is necessary that uniform reports be submitted. As the individual activities must combine the data of their separate departments, so the bureau must do, and even with the use of blank forms many reports are of no value because of carelessness in their preparation. It was found in the "Reports of annual expenditures and stock on hand," as submitted, that very few differentiated between the various sizes or types of the items, many failed to note whether the unit was single, pairs, or dozens, and so many failed to include items of stationery that an average rate of use for these items could not be determined.

The many errors in the preparation of Form 4 requisitions, which were no doubt the result of carelessness, have been brought to the attention of the bureau.

It is believed that any errors in the preparation of the new Form 4 requisitions in conjunction with the new supply table will be due entirely to carelessness, as the use of the stock number for each item will be an additional check.

It seems superfluous to try to explain each detail of the new supply table, which is self-explanatory. The items are alphabetically arranged in classes, according to their general use, as heretofore, and further classed as "Equipment" (nonexpendable items) and "Supplies" (expendable items). Many items of drugs have been deleted in revision, as the rate of use did not warrant their retention. One addition to be noted is the satchel for medical officers, the issue of which will be limited to those medical officers of dispensaries concerned with visiting the sick in out-patient service, and those of tenders and "mother ships" who have occasion to visit the sick of the smaller vessels, in order that a stock of some items that the medical officer might be called upon to use need not be carried on these smaller vessels.

It will be found that certain items are designated by the letter (p), which means that such items will not be furnished by medical supply depots in time of a national emergency. Experiences of the late war demonstrated that the procurement problem is a large one, and limiting the number of these items that are difficult to procure to those absolutely essential simplifies procurement, reduces transportation, and conserves storage space.

Some items are designated by an asterisk, which means that they will be issued until the present stock is exhausted. Such items are considered as of questionable value, but in the interests of economy the large stock on hand must be used before replacements can be made with more desirable items. In the case of surgical instruments it is contemplated by the bureau to issue an "ideal" assortment when conditions will permit.

Some items as listed in the contents of special outfits are not listed for requisition purposes and have no stock number. These items are considered obsolete and will not be replaced.

When an item is specified as a part of another item or for special outfits, it should only be required for the purpose specified. No doubt petrolatum in 1-ounce tubes would be more convenient to use in some cases than that in pound tins, but it would not be economical in all cases. These items are obtained at an additional expense to meet the requirements of the special outfits and should be used for that purpose only.

Every member of the medical department should be familiar with the contents of the Supply Table, 1926, and, as contained in binder with the Manual for the Medical Department, it should be readily available to all concerned.

EARLY TREATMENT OF FACIAL INJURIES

By L. W. JOHNSON, Lieutenant Commander, Medical Corps, United States Navy

One of the most admirable achievements of the medical department of the United States Army during the World War should be credited to Colonels Blair and Ivy and their associates of the maxillofacial section. This was the indoctrination of the members of the Medical and Dental Corps with certain definite principles and methods of early treatment of facial wounds. The lessons learned by the earlier combatants at such terrible cost were available for our use when we entered the war and the principles based on this knowledge were taught to our officers, with the result that the extreme types of facial disfigurement were almost entirely prevented by proper conservative treatment immediately after injury.

The methods and the skill developed in this field of surgery have since found wide application in the prevention and correction of disfigurements due to the accidents of civil life.

An important principle developed in recent years is the necessity of continual cooperation of the surgeon and the dental surgeon. In the Navy we have closely associated with us the Dental Corps, composed of carefully selected men, skilled in oral surgery, to cooperate with us in the care of maxillo-facial injuries and diseases. In many of these cases the general surgeon and the dental surgeon, working together as a team, can produce results greatly superior to those which either could accomplish alone.[1] The dentist has detailed knowledge of the anatomy and pathology of this region and is specially skilled in manipulations about the mouth, while the surgeon is versed in the general surgical principles which are essential to successful operation in any field.

There are now, in most of our cities, men who are skilled specialists in maxillo-facial surgery and able to handle alone any injuries in this region. But only a few of the facial injuries come immediately into the hands of these experts; most of them are first seen by the general practitioner or the dentist, and very frequently what the first man does may make or mar the ultimate result. Successful reconstruction must rest on a foundation of skillful primary treatment. Therefore it is essential for all practitioners, whether dental or medical, to give careful consideration to the principles of early treatment.

Let us first consider the cases in which the soft tissues alone are involved.

Nowadays we see many patients with deep cuts caused by broken glass in automobile accidents and this injury may be taken as typical of a large proportion of those occurring in civil life. The lacerations may involve the parotid gland or duct, the masseter or temporal muscle, the larger blood vessels and branches of the facial nerve, all of which will require individual attention. Hemorrhage must usually be the first consideration and, while it is frequently profuse, it is seldom dangerous if there is anyone present with sufficient presence of mind to apply pressure to the bleeding points. One must always bear in mind the possibility of tetanus. The organism causing this disease has its normal habitat in the intestine of herbivorous animals, so manure, road dust, and garden earth must be considered as probably contaminated and, in nearly all cases, it is better to give the patient the benefit of the doubt and inject the prophylactic dose of antitetanic serum.

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[1] Johnson, L. W., U. S. Naval Medical Bulletin, XXII; 4; April, 1925, p. 415.

Next we must consider cleanliness of the wound. This means not only the removal of all foreign particles but also some means of sterilizing those which can not be removed. Foreign bodies are virulent sources of infection and must not be allowed to remain. Various solutions may be used for sterilization of the wound—iodine, gentian violet, mercurochrome, or the chlorine preparations. Of the lot, tincture of iodine is probably most generally available and most reliable. Each of the other substances is more active against certain groups of bacteria than against others, or is unstable, but iodine gets them all, even the spores of the tetanus bacillus.

Then all parts of the wound should be carefully examined to see if there are any particles of tissue which have lost their blood supply, may become necrotic, and so favor bacterial growth. The very rich blood supply of the face favors us in reducing sepsis, first by keeping alive small shreds of tissue which might otherwise die and provide a haven for bacterial growth and, second, by bringing to the wound a generous amount of the body's own defensive agents. So, extensixe debridement is rarely necessary about the face.

If there is no extensive soiling, it will be possible to close at once the sheath of the masseter, the temporal fascia, and other important deep structures, draining if necessary. Closing without drainage is safer with clean incised wounds than with those which show considerable bruising or tearing. If the sucking pad of fat, deep in the cheek, anterior to the masseter muscle, is exposed, a drain down to it should be left in for 48 hours.

The duct of the parotid gland is more often cut through than those of the other salivary glands. It is protected to some extent by the zygoma and its deep location, but one should always remember the possibility and look carefully for evidence of injury to it in wounds of the cheek. It is rarely possible to suture accurately the duct itself, so reliance must be placed on coapting sutures in the surrounding tissues. Accurate adjustment of the cut ends may be assisted by a very fine filiform bougie or lachrymal probe introduced from within the mouth past the point of injury, to hold the severed portions of the duct in their proper positions while suturing. The secretion of the gland will escape by the easiest way, and the object is to make the natural outlet the easiest and so avoid the formation of a salivary fistula. If there is considerable loss of tissue, including the distal part of the parotid duct, a suture may be passed around the end of the duct and this secured to the mucous membrane so that it will open within the mouth when healing has become complete.

Nerves to the muscles of expression are frequently cut. The middle branch of the facial, which supplies the *zygomatici* and the

levator labii superioris, is more often cut than the nerve to the *depressor labii inferioris*, which runs most of its course beneath the mandible, or the nerve to the *frontalis* and *orbicularis palpebrarum*, which runs above the zygoma. If the patient can whistle, wrinkle his face, close his eyes tightly, and wrinkle his forehead, there is no serious nerve injury. Accurate suture of these very small nerves is rarely possible and so we must depend on coaptation sutures in the adjacent tissues to bring the cut ends as close together as possible. In this locality there is about 60 per cent chance of restoration of nerve function if the cut ends are within a quarter of an inch of each other and if there is no infection of the wound. Sepsis, and the fibrosis that result from it, cause very grave interference with nerve regeneration. If a nerve is cut, one should look for evidence of return of muscular control in 8 to 12 weeks after closure of a clean wound. In this region there does not exist the same need of massage and electrical treatment of the paralyzed muscles that we have in similar lesions of the limbs, but I am convinced that massage is of distinct benefit in the healing process.

Shall the wound be closed at once or shall we wait and do delayed primary suture after we are sure it will be clean? This is a most important decision and one in which many considerations are involved. Delayed suture may mean more granulation and contraction, possibly distortion by gravity or muscular pull, while too early suture and inadequate drainage mean extension of infection, possibly necrosis, loss of valuable tissue, stitches torn out, and more scar tissue. The decision must be based on the character, location, and extent of the wound, the probability of infection, and the amount of tissue lost.

Incised or lacerated wounds of the ears, eyelids, or nose, and those traversing the vermilion border of the lips should usually be repaired immediately. Drainage should be used if there is sufficient loose areolar or fatty tissue in the neighborhood to make it probable that considerable swelling will follow. Aseptic healing can not be expected if the wounds penetrate into any of the mucous-membrane lined cavities; practically all of these wounds require free, dependent drainage. When there is considerable loss of tissue in a wound which enters the mouth or nose, we should follow the principles laid down by Gillies and suture skin to mucous membrane all around the margins of the opening, leaving as little raw area as possible to undergo granulation. When the vermilion border is cut, we should be especially careful to get an accurate adjustment of the parts, for any irregularity of the border is very conspicuous.

Gunshot wounds of the face must always be considered as infected wounds. After all foreign bodies are removed and grains of powder

picked out to prevent tatooing, the wound should be swabbed with iodine or other antiseptic and drained, or else left wide open while waiting for the sepsis to appear.

These wounds of the soft tissues alone are relatively simple to manage when compared to those which involve the bone. Here especially we need the assistance of the dental surgeon, whose most important duty is the control and fixation of bony fragments by prosthetic or other means.

All pieces of bone which retain periosteal attachment and can be retained in approximately their normal position should be saved. Small pieces of bone without blood supply, as well as roots and broken teeth, should be removed, because they favor the persistence of sepsis if they remain as loose foreign bodies in the tissues. Every effort is to be made to fix all retained fragments of bone as early as possible in their proper position, since this greatly favors early healing and reduces the amount of late repair work. Frequent röntgenograms are of the greatest value in diagnosis and as a control during the time of healing.

Fractures of the mandible may produce edema of the submaxillary region or, by relaxation of the muscles controlling the tongue, cause serious interference with the respiration. Replacement and retention of the fracture will usually relieve this. If there is loss of a portion of the mandible with the ends of the bone exposed, the ends should be covered as far as possible by sewing the soft tissues over them. The remaining fragments then should be fixed to the upper teeth, or in some other manner, so that the support to the base of the tongue will not be lost.

Fractures of the maxilla, especially those with considerable loss of its substance, will frequently tax to the utmost the prosthetic skill of the dental surgeon. Early replacement and fixation are essential because of the important rôle played by this bone in its support of those most useful and conspicuous features, the nose and upper lip. Fractures of the zygoma may sometimes be corrected by using a sharp hook thrust through the skin, but more often an open operation will be necessary.

All of the injuries which involve the maxillary bones will require complete toilet of the mouth with removal of all septic roots, broken teeth, or other conditions which may favor sepsis. The duty of producing and maintaining the proper cleanliness of the mouth belongs to the dentist and this is often a heavy responsibility. When there is injury of the bones it is doubly important for one to restrain one's natural desire to close the disfiguring wounds at once, to stretch the soft tissues across the gaps, and to suture tightly. Such treatment tends to obstruct the blood supply, interfere with drainage,

and produce the three dreaded sequels, secondary hemorrhage, edema, and sepsis.

Secondary hemorrhage practically always results from sepsis. Occasionally a hard foreign body in contact with the wall of a blood vessel may be a factor. It is not a frequent complication of the wounds of civil life. The treatment is to open the wound widely and secure the bleeding vessel. This is a simple matter if one is familiar with the blood supply of the part. Occasionally there is hemorrhage from a vessel within a bony canal, or otherwise inaccessible, which may require ligation of one of the large vessels in the neck, a procedure which is relatively safe in the young but may cause hemiplegia in the aged.

Edema results primarily from interference with the blood supply, especially the venous or lymphatic drainage, so that an excess of fluid collects in the tissues. There is distention and maceration of the tissues and the tension may increase so far as to tear out the sutures. The waste products of metabolic activity are not promptly removed, the oxygen supply is reduced, and the acid content is increased. Martin Fischer has shown that this increased acidity has a specific action in increasing the edema. The excess fluid collecting in the tissues may cause so much distention as to tear out the sutures. Wherry and Hogan, of the University of Cincinnati, demonstrated that bacteria grow better in edematous tissue than in normal tissue, where all the water is held in intimate combination by the proteins. Bacteria which will not grow at all in the normal tissues will grow with increasing energy in proportion to the added amount of water which collects in the tissues, and removal of the excess fluid results in their death without any other antiseptic action being required. This is one reason for the well-known efficacy of the astringent and dehydrating applications such as saturated solution of magnesium sulphate and Wright's hypertonic saline solution.

The edema should be treated by removing all sutures, opening the wound freely, and applying hypertonic salt solution as a wet dressing. A very rapid improvement will be observed after this is done, and the sooner it is done, the less will be the permanent damage to the tissues. Early massage and radiant heat or exposure to sunlight are also valuable aids.

Sepsis is rarely a dangerous complication when properly handled. If it occurs, remove the stitches, examine carefully once more for foreign bodies, such as metallic particles, dirt, or fragments of bone. Wright's hypertonic saline solution with sodium citrate is very useful as a wet dressing. The chlorine compounds, such as Dakin's hypochlorite solution and dichloramine, are poorly adapted for use in this region, and the dyes, such as mercurochrome, gentian violet,

and flavine, are to be used with great caution because of the occasional occurrence of tattooing after their use. The surfaces may be cleaned by swabbing or spraying with hydrogen peroxide and the wet dressing of Wright's solution then applied. This solution consists of sodium chloride, 50 grams, and sodium citrate, 5 grams, to the liter of water. There is a constant outflow of serum when this solution is used, which rapidly dehydrates the tissues and kills or removes the bacteria. Frequently the improvement is so rapid that secondary suture can be done after 24 to 48 hours of this treatment.

Erysipelas is a rather common complication, especially of wounds involving the nose. It is seldom serious and can usually be controlled by continuous application of a pad of about eight thicknesses of gauze kept constantly wet with saturated solution of magnesium sulphate.

Anesthesia may be unnecessary in repair of facial injuries in adults, especially if done soon after the wound is received. Children will usually require general anesthesia if accurate sewing is to be done. Local anesthesia will be the method of choice in many cases and for painful dressings in adults the ether cocktail, recommended by Gwathmey, will often be found satisfactory. This may be of varying strength, according to the individual and the length of analgesia required. Ether, 16 grams, liquid petrolatum, 16 grams, and peppermint water, 0.4 gram, is a weak one. Chloroform, 5 grams, ether, 20 grams, and liquid petrolatum, 20 grams, is much stronger. They are administered by mouth and there is usually a period of excitement lasting a few minutes, followed by a deep sleep and analgesia, during which the dressing or sewing may be done. Oil-ether colonic anesthesia is valuable for more extensive repair work.

When closing deep facial wounds it is essential not to neglect suture of the deeper layers with absorbable material. This obliterates dead spaces, prevents collection of extravasated blood in the tissues, and lessens the amount of fibrosis and contraction after healing.

Dressings should be as small as possible, not only for cosmetic reasons but also because the smaller dressing is more comfortable and makes inspection easier. It also produces less maceration of the tissues than the large dressing, which retains more of the heat and moisture. If the wound can be closed and accurately sutured, simply painting it with compound tincture of benzoin will often suffice. This forms an air-tight protective coating like a varnish. Raw surfaces or skin-grafted surfaces may be covered with vaseline gauze or netting impregnated with paraffin, both of which can be removed without tearing the fresh granulations.

Drains should be of some impervious material rather than gauze, the meshes of which soon become filled with coagulated serum, causing it to act as a plug instead of a drain. Rubber dam, rubber bands, or strands of suture material are very satisfactory drains.

In closing I wish to emphasize once more the value of cooperation between the dentist and surgeon in the treatment of facial injuries.

ENCEPHALITIS LETHARGICA[1]

By H. M. F. BEHNEMAN, Lieutenant, Junior Grade, Medical Corps, United States Navy

The object of this paper is to present the results of an extended study of lethargic encephalitis during the author's service in psychiatry wards. A distinct difference was noted in the symptoms of four patients at the United States naval hospital, Mare Island, Calif. (Pacific coast), from the picture of cases reported in the literature from the Atlantic coast. All records of patients with this diagnosis in the Mare Island hospital since 1913 were carefully studied. These show only 28 cases of lethargic encephalitis in 12 years. The chief object, then, of this paper is to point out the dissimilarity of the clinical picture of this disease on the two coasts of this continent. As an essential part of the material presented, there is a survey of the later literature, with the proper attention to history, etiology, diagnosis, pathology, animal experimentation, serology, treatment, prognosis, and sequelae.

FOREWORD

In the great majority of instances the most difficult phase of medicine is diagnosis. It may be the simplest, but again it may be the most difficult, elusive, and perplexing problem. If every disease had one clinical picture, what a simple procedure the practice of medicine would be! There are many factors which contribute to the variety of pictures for the same condition. Of course the individual comes first, with his variable resistance or idiosyncrasies. The severity of the malady may come next. What I consider a good third in the list is locality. This last factor is of prime importance and consideration to a medical officer in the military service; that is, Army or Navy. His stay in one area is short; his "visit" usually gives him but a fleeting glimpse of many pathological conditions.

The earliest possible diagnosis of his patient's malady is the obligation of every physician. Until the condition is named treatment is either impossible or of little use. In the milder illnesses no damage may result from nonrecognition of the trouble, but in the severer

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[1] From U. S. Naval Hospital, Mare Island, Calif.

ones life may depend upon it. Among the latter is that rather late, puzzling, resistant entity—encephalitis lethargica—of insidious onset and often disastrous farewell.

It is not often that diagnosis is established early in this disease because it is very difficult to detect it. The writer found such a difference in the outstanding characteristics of the condition between the cases reported at the Mare Island hospital and the majority of cases reported in the literature elsewhere in the United States that he feels it is pertinent to point out the chief diagnostic signs on the Pacific coast. This, then, establishes the purpose of the paper—to aid in early diagnosis.

History

Two hundred and thirty years ago, in 1695, *lethargic fever with disseminated eye signs* was a known entity. Twenty years later, Camerarius described an epidemic of "grippe" in Tubingen, and gave the name "Schlafkrankheit" to the picture associated with it. In Germany, 50 years later, in 1765, there was an outbreak of lethargy with eye signs. It was described by Ozamann as "an epidemic of catarrhal fever with Soporsite." The cities of Lyons, in 1800, and Milan, in 1802, are supposed to have suffered from a similar epidemic. "Coma somnolentum" was the name that Lepecq de La Cloture gave to a condition appearing after the grippe. About 1890, a similar epidemic appeared in Italy, Hungary, and Germany. Longette described it under the name of Nona ("Nonna").

The next appearance was in 1918–19 after the outbreak of influenza in this country. About the same time, or a year previously, Von Economo described a similar condition under the name of "Nona" following the outbreak in Vienna. The name "lethargic encephalitis" originated in either Austria or Australia, where it had appeared just prior to the Vienna outbreak. "Sleeping sickness" was a later synonym—and a worse one. So, one sees that it has been a universal malady, cropping up with years between outbreaks, and each outbreak thousands of miles apart. Many types have arisen from its world-wide history, the chief ones being:

Lethargic.
Parkinsonian.
Cataleptic.
Polioencephalitic.
Choreic.
Myoclonic.
Meningitic.
Epileptiform.
Multiform.
Acute psychotic.
Neonatorum.

Etiology

Here hypotheses rule. Nearly all authorities definitely agree, however, that syphilis, trauma, and alcohol play no part in this disease. It is similar in many points to acute poliomyelitis; both are infectious, the central nervous system is the point of attack in both, and both are sporadic in appearance. On the other hand, however, they do not appear simultaneously. There was no evidence, according to Reese, of any increase in poliomyelitis in England and Wales during the first three months of 1919, although epidemic encephalitis was extremely prevalent. Also, poliomyelitis is a disease of children, whereas encephalitis is an adult condition.

Influenza has persistently been put forth as a causative or necessary factor. Von Economo has suggested that the virus of encephalitis actually requires activation by that of influenza. The most that can be said, in my estimation, after reading many of the voluminous theories about this relationship, is that influenza is probably a predisposing factor. However, I see no cause whatever to even connect it with any more than three of the 28 Mare Island cases. True, the clinical signs of influenza often usher it in, but then we know that a rash ushers in many different conditions. Just because two diseases are epidemic at the same time is no proof that they depend upon the same infection.

Views and work of others are highly interesting. Sahli believes that the virus of epidemic encephalitis is a part of the influenza "complex" with which it lives in symbiosis. Rosenow has isolated a streptococcus which he considers the cause, but this has not been confirmed. Harvier ruled out poliomyelitis as a causative factor. Reese still believes epidemic encephalitis is a nervous manifestation in influenza, but offers no proof. Kling's virus produced characteristic encephalitic changes in the brain stem, but cultures from the infected animals remained sterile. Von Wiesner did some work on the monkey which has not been accepted as proof of cause, but he, with McIntosh, proved that poliomyelitis played no part.

The followers of the filterable virus theory are numerous.

Strauss and Loewe have isolated an ultra-micro-organism which they believe to be the etiological factor in epidemic encephalitis. Amoss, Levaditi, Harvier, and McIntosh have substantiated the transmissibility of the infection to animals. Others, too, have corroborated these findings, but have not isolated any organism. Strauss and Loewe succeeded in transmitting the virus through four generations of rabbits and back to the monkey in the fifth generation, and again into the rabbit in the sixth generation, producing like symptoms and pathology as found in the human cases.

The virus can be recovered from the naso-pharyngeal mucous membrane of the rabbit inoculated with mucous membrane washings

from a patient suffering from epidemic encephalitis better than from the injection of washings from the infected nerve tissue. We must remember, however, when experimenting with rabbits, that they respond with symptoms of encephalitis from almost any foreign injection. For this reason many have not accepted as definite proof the work done with the various filterable viruses.

So stands the etiology—one can take his particular theory and defend it well.

Age.—Bramwell recorded the average age of onset in males as 43 years and in females 35 years. (See Table VII.) The Mare Island cases averaged 14 years below this—29 years of age in males.

Season.—Encephalitis is much more common in the winter months. In contrast, poliomyelitis is a disease of the late summer and autumn.

Sex.—Males predominate over females in the proportion of about 60 to 40.

Incubation period.—This has been put at about 10 days. Much longer time may elapse, however, before discernible symptoms arise.

Course.—This is very indefinite and may last from one week to years.

PATHOLOGY

The pathology is as varied as are the theories of etiology. It is plain, however, that this infection shows a special predilection for the brain stem. Extensive pial injection with hemorrhages on the surface of the brain have been observed. Foci of perivascular round cell infiltration scattered throughout the central nervous system, and particularly the brain stem and basal ganglia, are frequently found. No change is apparently noticeable to the naked eye. On microscopic examination these punctate-appearing hemorrhages are usually only dilated vessels. Miller says that the perivascular infiltration is never found around the meningeal vessels. Sometimes there is a neuroglia increase. Jaffe believes the pathology is that of any acute infection. Buzzard has found that the overgrowth of glia cells is the most striking change. Findings are really variable, owing to the variable course of the disease. Quinter, Gilbert, and Adeline give the pathology of four distinct types of encephalitis. Jelliffe presents a masterly analysis of a patient "who had an encephalitis." Weinberg states that classification is impossible. Predilection for basal ganglia is evident, as well as for the floor of the fourth ventricle. Buzzard summarizes the pathological changes:

1. Vascular congestion.
2. Evidence of toxic degeneration of nerve cells.
3. Proliferation of the mesoblastic cells of the vessel walls.
4. Small cell infiltration of the Virchow-Robin spaces.
5. Glial proliferation.

Pothier, reporting the epidemic of 1918, points out that 50 per cent of the fatalities showed involvement of the vital bulbar centers.

Types

Friedman classifies the symptomatology under the following types:

1. Mesencephalic type:
   Lethargy and ocular palsies.
2. Pseudoparkinsonian type:
   Rigid expression; stare; facial weakness, and Parkinsonian gait.

These patients may present themselves with complaints simulating any other condition. They may go to the eye service for diplopia; to the genito-urinary service for retention; to the laryngological service for sinus infections and facial paralysis; to the surgical service with a diagnosis of an acute abdomen; and, finally, to the psychopathic service as a result of manic episodes, occupational deliriums, or catatonic stupor.

Reinhardt presents the following classification:

1. Mesencephalic type with ptosis and other eye signs and lethargy.
2. Hyperkinetic type with chorea or myoclonia.
3. Amyostatic type with paralysis agitans syndrome.
4. Psychotic type with delirium or catatonic stupor cases.
5. The abortive type, with transitory ocular and facial palsies.

MacNalty suggests a grouping of types which closely resembles the above, only his comprises nine differentiations. Later, on an anatomical basis, he describes the following types:

1. Clinical affection of the third nerve.
2. Affection of the brain stem and bulb.
3. Affection of the long tracts.
4. Cerebellar affection.
5. Affection of the cerebral cortex.
6. Spinal cord involvement.
7. Polyneuritic type with peripheral nerves affected.

Buzzard, in a classical dissertation on the subject, divides the disease into groups depending on certain clinical syndromes produced. His grouping is as follows:

1. Those cases characterized by hemiplegia, hemianesthesia, and hemianopsia.
2. Those cases characterized by symptoms resembling paralysis agitans.
3. Those cases characterized by disturbances of function of the spinal nerves.

As an explanation of the lethargy, Buzzard says it may be due to hydrocephalus produced by the inflammation and edema in the region of the corpora quadrigemina interfering with the circulation of the cerebrospinal fluid through the aqueduct of Sylvius.

To me, Friedman's classification seems the most sensible for the busy practitioner of medicine, for, after all, treatment does not depend so very much on type, especially when types are numerous. Happp and Mason divide the diseases into four types.

Onset

Bramwell classifies types of onset as follows:

1. Abnormal drowsiness—tendency to sleep at any time.
2. Diplopia.
3. Defective vision due to paresis of accommodation.
4. Feeling of light-headedness.
5. Loss of emotional control.
6. Constipation.
7. Difficulty in urination.
8. Pain simulating peripheral neuritis.

There are cases on record, however, where no prodromal signs were noted; the patient retiring apparently in excellent health only to arise with marked manifestations of epidemic encephalitis.

Type of onset is in reality the chief complaint. The chief complaints of the Mare Island series and the eastern series are shown in Table V.

Symptomatology

This may vary to a great extent, as is seen from the variety of chief complaints and predominance of symptoms.

A typical case, however, does present a striking picture. The patient may lie on his back motionless, not attempting to move for hours, with eyes half closed. The face may be flushed and covered with beads of perspiration. He may be in only a moderate degree of somnolence.

Again, although the patient may be oblivious to his surroundings, he may be restless, talk aloud, or mutter to himself. He evidently is disorientated, for in his delirium he frequently refers to his occupation. The child continues to recite his school lessons, etc. Such examples of an occupational delirium are commonly met with in this condition. The lips may move and yet the face be strikingly expressionless. Frequently there are myoclonic twitchings of the facial muscles. Lethargy is seen in grades from stupor to an actual coma. The temperature and pulse may or may not be elevated; there is usually a slight increase in both. Rarely there is a leucocytosis. The tongue is usually coated. There may be herpes or diffuse erythema.

Holstrom reports a series of 27 cases in which he briefly summarizes the most constant findings, as follows: "All had fever and

there had been a longer or shorter period of somnolency in all; they also had nystagmus, vertical or lateral, and the majority had diplopia."

By referring to the tables of symptoms as mentioned before, one can see the wide variance of the pictures.

Diagnosis

Reference again to the tables will show the outstanding symptoms from which diagnosis may be made. Spinal-fluid findings will be discussed later.

Barker gives three stages or periods for diagnosis:

1. Influenza features:
   (a) Fevers.
   (b) Drowsy.
   (c) Meningeal symptoms depending on cord, bulbar region, basal ganglia.
2. Residual neurological manifestations; psychic disturbances.
3. Post-encephalitic syndromes.

There is a great clinical resemblance between the symptomatic paralysis agitans (Parkinsonian syndrome) and the true paralysis agitans. It is necessary that the physician make this distinction. The tables summarize briefly:

Parkinsonian syndrome	*Paralysis agitans*
Occurs before 36 usually.	After 45 usually.
Rapidly progressive.	Slowly progressive.
Male and female equally attacked.	Male in 90 per cent.
Relapses and remissions common.	Rare.
Tremor not characteristic.	Characteristic pill roller.
History of an acute infection.	None.
Lethargy.	None.

H. L. Parker had three cases of brain tumor closely simulating encephalitis lethargica. The patients showed a short history, fluctuating course, and diffuse bilateral signs. The tumors were at the base of the brain and in intricate relationship with the third and fourth ventricles. General signs of tumor of the brain were not marked and neurological signs were bilateral.

Just how long we will be able to count on a certain set of symptoms is doubtful. This peculiar malady seems to change its symptoms from year to year. In 1919 and in 1920 the predominating symptoms were drowsiness, ophthalmoplegia, pupillary and bladder changes, and headaches, with neuralgic pains in the limbs. In 1923 there seemed to be an entirely new set of symptoms. But it is interesting to note that the pathological findings in the brain and cord were about the same.

The laboratory findings are most valuable.

Laboratory Findings

Spinal fluid.—This examination is of highest value and should be thoroughly considered. The fluid is usually under little or no pressure. It is clear and colorless. The cell count may range from 5 to 150 or more cells, depending on the stage of the disease. Generally speaking, the more acute the case the higher the cell count. In the Mare Island series, however, all three low-count cases died, but there is no record of when that count was made in the course of the disease. The cells may be mononuclear or polynuclear in type.

Eskuchen describes two types of spinal fluid found in epidemic encephalitis: One, lymphocytosis, with increased globulin, luetic gold curve, and increased sugar content. Secondly, lymphocytosis, with decreased cell-globulin, luetic gold curve, and increased sugar content. The appearance of both is clear and colorless and there is no increased pressure.

Barker says:

In my experience a cell count in the spinal fluid of from 1 to 100 small mononuclears along with a positive globulin test, a negative Wassermann and bacteriological smears and cultures, with an increased sugar content, is, at the time of an epidemic of encephalitis, strong corroborative evidence of the existence of the disease in a patient in whom the process is for any reason expected to exist.

Following are the differential points in the spinal fluid of conditions simulating encephalitis lethargica:

1. Tuberculous meningitis—increased pressure, pleocytosis (60 to 325), pellicle formation, and tubercle bacilli. Sugar is rarely above 0.05.
2. Cerebrospinal meningitis—cloudy fluid, flocculent, leucocytes, meningococci in some cells, sugar very low, 0.01–0.02. Cell count, 100 to 15,000.
3. Central nervous system lues—Wassermann, 4 plus, marked pleocytosis, increased globulin, paretic or luetic gold curve.

Foster and Cockrell report a series of 35 cases, with sugar content of spinal fluid ranging from 0.0400 to 0.0600, practically normal limits. Laporte and Rouzard obtained an increase in blood sugar in their cases. Bourges, Foerster, and Marcandier confirm the above. This seems to be true of most French investigators. Eskuchen did not agree, while Polonovski and Duhot do agree. Foster and Cockrell conclude that—

1. A high sugar content is not pathognomonic of encephalitis lethargica; normal sugar is rare, and low sugar unknown to them.
2. They obtained sugar above 0.0600 in 91 per cent of their cases.
3. Sugar content is valuable in differentiating this condition from tuberculous meningitis.

Weinberg found one high sugar in 35 cases. His other findings in spinal fluid were: Twenty-three out of 26 cases showed an increase

in cell count of from 6 to 16, and all were under great pressure. Ninety to 95 per cent were small mononuclears; plasma cells were present occasionally; globulin was definitely increased in 24, and slightly so in 7 cases. Wassermann test was negative in all but one case. Howell disagrees with Weinberg's findings. (See Table VI.)

Urine.—There are no specific findings here. Frequently one may find a mild nephritis.

Blood.—This is not of much significance. Cultures are negative. There may be a leucocytosis or a leucopenia. The differential count is that usually found in response to an infection. The French claim that a high spinal-fluid sugar content is accompanied by a hyperglycemia; if this is so, then the latter should be a fairly constant finding.

It is to be regretted that if spinal-fluid sugar content was determined in the Mare Island series it was not recorded in the charts. There is no record to be found, but the health records were not seen. Such knowledge of the spinal-fluid contents as outlined above is of vital aid in diagnosis.

Sequelæ

Grossmann reports that 10 cases out of 92 showed permanent sequelæ. The remaining effects were: Alteration of reflexes, paralyses, pupil changes, masque face, tremors, Parkinsonian symptoms, speech disturbance, nystagmus, disturbed gait, Babinski, ankle clonus, mental retardation, hypotonia, cerebral symptoms, irritability, etc.

Seven showed residual symptoms, but were able to go to work. The five chief symptoms were: Pupillary changes, palsies, altered reflexes, nervous changes, irritability.

In a series of 97 cases reported by Bing and Staehlin, 50 per cent showed the residual Parkinsonian syndrome. It is interesting to note that only 24 of the 80 cases who did not die in the acute or subacute stages were free from sequelæ two years later. Of the last 10 cases of lethargic encephalitis at this hospital all have developed the Parkinsonian syndrome.

In no other disease is the question of sequelæ of such importance as in this condition. The average duration of the acute and subacute stages is from two to six weeks. Signs that may have or may not have been present during the stages of "incipiency," "active involvement," or the stage of "the disease with the decline," became evident and frequently permanent in the "stage of sequelæ" in 80 per cent of the cases.

Peculiarly, those symptoms that are the last to appear are the most apt to stay longest. The mildness of the attack bears absolutely no

relationship to the seriousness of the sequelæ. The most important sequelæ as given by Friedmann are: Parkinsonian syndrome and choreo-athetoid sequel. There may be a chronic Babinsky present, interpreted as a result of the dominance of the basal ganglia.

Obviously, the Parkinsonian syndrome forms an important part of the post-encephalitic changes. Bing and Staehlin in a series of 97 cases noted this type of sequel in 37 per cent. Grossmann in a report of 92 cases gives still a higher percentage—43 per cent.

Many cases are on record in which no sequelæ were noted as long as 15 months after the acute attack, only to have the Parkinsonian syndrome precipitated at this time by various means clinically and pathologically unaccountable—for example, anesthesia, fear, etc.

Children under 10 years of age are most liable to severe complications. Early marked "negative mental symptoms" (lethargy, drowsiness, and coma) are associated with severe mental sequelæ; whereas those with "positive mental symptoms" (restlessness, delirium, and mania) are not so frequently associated with mental symptoms; and when so associated, the symptoms are much fewer.

The physical sequelæ found in about 75 per cent of all cases are nearly always a residue of the lesions present in the acute stage. They include: Cranial nerve palsies, Parkinsonian syndrome, post-encephalitic chorea, hemiplegia, trophic changes, sensory changes.

The Parkinsonian syndrome found in about 35 per cent of Duncan's cases is present in all gradations, from a slight rigidity and masklike face to an extensive "lead-pipe" rigidity with or without involuntary rhythmical movements. In about 90 per cent of the cases with a Parkinsonian syndrome sequel there were also added cranial nerve palsies—the most common being the oculomotor.

The mental state is found to be proportional to the severity of the physical sequelæ. If the clinical features of the Parkinsonian syndrome are only moderate there is usually little or no mental disturbance; the converse also holding true.

All four cases aforementioned as being here at the Mare Island hospital have been out of bed two months or more. All of them show marked sequelæ, and all of the Parkinsonian type. There is no noticeable mental retardation in any in the sense of destruction—of course there is delay in execution. They are all on duty around the hospital, except one who is in the lock ward. He shows some disturbance in vision which looks as if it will be permanent. Poor vision, by the way, was his first and chief complaint. The masquelike face is the predominating feature of these cases. They are all awaiting survey and transfer to Veterans' Bureau hospitals.

Prognosis

Out of a total of 850 cases compiled by Wechslar there was a mortality rate of 21 per cent. Fatal terminations were most common in those cases which began with a high fever and in those with a very acute onset. Too, the mortality rate was high in the so-called "psychotic toxic delirious group," and in those with severe meningitic involvement. Those remaining, however, do not represent the complete recoveries, for, of them, about 70 per cent showed "scars of the disease in various forms of sequelæ." Included in this group were the Parkinsonian residuals, the ocular palsies, and those patients showing abnormal involuntary movements such as tics, tremors, epilepsies, and psychic or mental disturbances. In a few instances, the disease took on a chronic form; especially was this true in the cases with the Parkinsonian syndrome and in those with abnormal involuntary movements. Many of these, however, continued to improve after many months of chronicity.

Bing and Staehlin report that of 80 cases, severe ones, who lived nine months after onset, only 24 were cured. Grossmann reports that 10 cases out of 92 recovered fully; 14 functionally well, 2 doubtful, and 4 improved. Sixty-two showed progressive involvement of the central nervous system with two-thirds of that number showing a clinical syndrome resembling paralysis agitans. (For mortality, see Table VII.)

There were only four deaths out of 28 cases at Mare Island. There have been no deaths in the last 18 cases so far as the records of this hospital show. Nine have been sent to duty, 4 have been transferred to other hospitals, and 4 are awaiting such transfer now.

Treatment

The question of treatment will be dealt with here in but a few words, as this paper relates primarily to diagnosis. The treatment of these cases is most unsatisfactory. Very few drugs in the Pharmacopœia have not been used. The treatment is largely symptomatic. The naso-phaynx should be sprayed with some alkaline antiseptic solution. All possible foci of infection should be carefully looked for and eliminated. Repeated lumbar punctures have been of some value. Serum treatment is more of less experimental. Rosenow claims encouraging results from an immune horse serum.

Hyoscine has proved of much value as a palliative agency in those cases presenting the Parkinsonian syndrome. The dosage varies from 1/200 grain to 1/50 grain, three to four times daily.

Barker has tried various modes of treatment—salvarsan, mercurochrome, trypaflavine, urotropine, and various sera, but he is certain that a successful chemotherapy for epidemic encephalitis has not yet been discovered. He feels that the more quickly the Parkinsonian syndrome develops after the first symptoms (acute stage) the greater the likelihood of recovery; the more slowly it develops, the greater the probability of the permanent sequelæ and a progressive course.

MacBride reports good results from intravenous injections of sodium salicylate; especially does he consider this mode of treatment valuable in the following types; myoclonic, excessive drowsiness, peripheral neuritis, and choreiform. The injections are given daily for seven days, in increasing doses beginning with ½ gram and working it up to 2½ grams as a final dose, a total of 10 grams being given. This therapy proved less successful in those cases with the post encephalitic Parkinsonian syndrome.

Netter has suggested that subcutaneous injections of turpentine may be tried in order to produce abscess formation (the so-called fixation abscess). This is recommended as an attempt to localize and anchor the infection in cases where it is generalized. He also suggests that inasmuch as the virus is supposed to be present in the saliva, one might attempt to increase the glandular secretions in the hope that an increased amount of the virus may be eliminated in this manner.

Again, it has been suggested that since, in this condition and in syphilis of the cerebral vessels, there was a perivascular infiltration, with somnolence and stupor, potassium iodide and arsenic should be tried, but this line of treatment which has been used by many has proved of no avail.

Royal and Hunter have attempted to remove the influence of the sympathetic innervation in the hope of relieving the spastic paralysis. Obviously the dangers of this procedure prevent its use.

It is evident, then, that the first statement herein made in regard to the treatment of acute epidemic encephalitis is still without question. The problem is an unsatisfactory one, and very few drugs in the Pharmacopœia have not been tried. The line of procedure is purely symptomatic, as there is no specific for this condition.

The patients now in this hospital have been treated symptomatically, with careful attention to personal hygiene, especially oral; the bowels kept open, and a nourishing diet forced to the utmost. Time alone seems to be the essential factor in the present therapy of lethargic encephalitis.

CASE HISTORIES

Histories of the four cases remaining in this hospital will now be given:

CASE 1

W. D. McD. (Eng. 1c); aged 28 years. Admitted April 15, 1925, with diagnosis "Encephalitis, lethargica." Had been admitted August 18, 1924, with diagnosis of "Psychoneurosis, unclassified." On February 27, 1925, was readmitted with diagnosis of "Psychosis, manic depressive."

Family history.—Negative.

Past history.—Usual childhood diseases; no influenza. Measles, February 15, 1915; gonorrhea, April 2, 1915; cholecystitis, August 10, 1921, acute; cholecystitis, March 11, 1922, chronic; cholecystitis, July 9, 1922, with gall bladder drainage; otitis externa, December 4, 1922; astigmatism, January 5, 1923; uncinariasis, April 24, 1923; astigmatism, August 6, 1924.

Present illness.—After correction of astigmatism in January, 1923, patient still complained of weakness, nervousness, and indigestion. This weakness was first complained of in January, 1922. Symptoms were very vague. Physical examination was negative. Gastric trouble had been present since 1921, following gall-bladder drainage mentioned above. Eye refraction on January 30, 1921, relieved patient of headaches and visual disturbances. In January, 1923, patient appeared worried and melancholic. Transferred to United States naval hospital, Portsmouth, Va., to be near sick wife. There condition slightly improved. On March 5, 1923, no evidence of psychosis. Diagnosis of "Uncinariasis" established. Patient much improved by chenopodium therapy and sent to duty April 24, 1923. Transferred to Hampton Roads, Va., June 7, 1923, complaining of pain in left upper abdomen. Transferred back to Norfolk for observation. Physical examination negative. No definite cause for symptoms. Sent to duty June 29, 1923, with decision that troubles were imaginary. On July 14, 1923, diagnosis of "astigmatism." Then he complained of aching pains in both legs on exercise. At this time his white blood count was 10,600. Given sodium salicylate and sodium bicarbonate. Condition had improved by July 17, 1923, and he was sent to duty. No further report until January 14, 1925, when he was admitted to sick list on U. S. S. *Colorado*. Complaint, weakness and lack of energy. Physical examination revealed exaggerated reflexes; spastic gait and spasticity of all muscles, with a fixation tendency; delay in execution of movement. Transferred to U. S. S. *Relief*. Patient said weakness was present July 17, 1923, when he was discharged from Hampton Roads.

Chief complaint.—On admission here January 14, 1925, complained of weakness, nervousness, stiff neck, "knees and legs always ache," occasional headaches, poor digestion. Bowels were all right; appetite was good. Physical examination revealed staring eyes, sluggish pupils, semiflexed arm position, coarse tremor of the tongue, movements deliberate, knee jerks absent, and gait slow. Wassermann negative on January 18, 1925. Diagnosis made on that date of "Psychosis, manic depressive." Observed on board ship and no improvement in physical condition noted. Mentally active; mind clear and bright. Transferred to United States naval hospital, San Diego; surveyed, and found unfit for duty on March 13, 1925. Transferred to United States naval hospital, Mare Island.

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Physical examination.—The physical examination at this hospital revealed the above findings. Mental summary shows patient has lack of education, but no definite psychosis. Somewhat depressed at times because of physical condition. Neurological examination revealed no changes in sensation. Slight swaying on Romberg test; slight incoordination of arms; weakness and rigidity of all muscles; difficulty in talking and swallowing. Gait stiff, slow, and jerky; tremor of facial muscles and fingers; staring gaze; reflexes all present and equal, but sluggish. Diagnosis of "Encephalitis, lethargica" established.

Course of disease.—April 22, 1925, no evidence of psychosis; quiet.

April 24, 1925, Wassermann negative.

April 27, 1925, unable to stand outside detail.

May 4, 1925, Hyoscine, gr. 1/100 twice daily; no improvement.

June 3, 1925, no definite change.

June 11, 1925, surveyed to Veterans' Bureau hospital.

July 24, 1925, no change; on messenger detail.

Patient is now active as messenger, but has staring gaze, is slow and jerky. Mentally he is clear, cooperative, and bright.

CASE 2

G. W. S. (Sea. 2c.), aged 25 years. Admitted September 1, 1924, from U. S. S. *Relief*, with diagnosis of "Epilepsy."

Family history.—One brother has tuberculosis. Mother died of tuberculosis; otherwise negative.

Past history.—Walked in sleep, 1913; measles, 1914; head injury, 1916; smallpox, 1917.

Present illness.—Onset unknown. Patient was told he had convulsions when a child; first known seizure four months after enlistment, at training station, Hampton Roads, Va., in January, 1924. He had subsequent attacks one to six months apart, but does not know anything about them. Had severe headaches and vertigo starting in March, 1924. Has a scar on scalp which is painful at times. Has never bitten his tongue nor lost control of his sphincters. Intelligence fair. Romberg, marked swaying; slight incoordination of hands; coarse tremor of hands; right arm not so strong as left and tendon reflexes greater. Complains of red spots before eyes and inability to localize; frequent winking. In August, 1924, complained of headaches. X-ray examination showed sinuses clear; sella well developed. Eyes: Vision, both 20/30.

The next entry in the health record was aboard the U. S. S. *Pennsylvania*, April 11, 1925, when he had a fit. Sent to the U. S. S. *Relief* April 11, 1925. Transferred to Mare Island, April 14, 1925; symptoms then the same except for progression.

Chief complaint.—The chief complaints at this time were headache, myopia, and poor vision. Signs of mental deterioration increasing, with emotional flattening.

April 17, 1925, complains of nervousness.

April 20, 1925, Wassermann, 3 plus, with cholesterin antigen; negative, with plain antigen.

May 4, 1925, suggestion of encephalitis lethargica. Now in a semisleep most of the time. Given hyoscine, grs. 1/100 twice daily.

May 24, 1925, listless; complains of weakness and takes no interest in environment.

June 3, 1925, lies in bed; no interest.

June 16, 1925, no change; no attacks since admission.

June 29, 1925, complains of weakness; brighter.

July 17, 1925, diagnosis: Encephalitis lethargica.

July 22, 1925, board of medical survey found him unfit for duty. To go to St. Elizabeths Hospital, Washington, D. C.

Case 3

J. H. B. (S. M. 1c.), aged 26 years.

Diagnosis.—Encephalitis lethargica.

Admitted from the U. S. S. *Relief*, April 14, 1925, with diagnosis of "Psychoneurosis, neurasthenia."

Chief complaint.—Weakness and drowsiness; loss of appetite; inability to concentrate for many weeks past.

Family history.—Negative.

Past history.—Fever two years ago, with inclination to sleep; semicoma for 10 days; weary and tires easily since.

Present illness.—Probably started with above. Very bright as a boy; graduated from high school at age of 16 years. Aside from above complaints, he now complains of collection of saliva and food in mouth. Loss of weight, 15 pounds.

Physical examination.—Myopia; expression masquelike; eyes fixed; mouth open, with protruding tongue. Voice expressionless; no psychosis. Some impairments of memory; posture and gait, Parkinsonian type. Fine tremor of fingers. Reflexes normal. Slow winking.

April 20, 1925, slight improvement under rest. Wassermann negative.

May 4, 1925, hyoscine, gr. 1/100 twice daily.

May 24, 1925, hyoscine discontinued; somewhat better.

June 4, 1925, diagnosis of "Encephalitis lethargica."

June 16, 1925, no change.

June 29, 1925, pain in both ears; being treated; marked cellulitis, both ears.

July 18, 1925, ears improved.

July 24, 1925, no change.

August 3, 1925, no change.

Case 4

F. C. G. (F. 3c.), aged 26 years.

Admitted April 16, 1925, from receiving ship, San Francisco, Calif.

Chief complaint.—"Can not see."

Family history.—Negative.

Personal history.—No bearing.

Present illness.—Patient was admitted to the receiving ship after desertion. The day after his arrival he complained of sore eyes. There was a conjunctivitis, which cleared up under treatment. He still could not see very well, however. Was confused and awkward. Complained of a headache, and objects moved in front of him. He was sleepy.

Physical examination.—Slight swaying Romberg. Marked vertical mystagmus. Fundus examination shows media clear. Consensual reflex active. Extraocular muscles normal. Reads 10/20. Question of malingering. X-ray examination of chest, negative. X-ray examination of skull, negative.

Spinal fluid: No increased pressure; cell count, 4 leucocytes; no increased globulin.

Wassermann test, positive to 2 c. c. dilution only.

Lange curve suggested tuberculous meningitis.

Surveyed August 1, 1925.

The present condition of these four patients is shown in Table I.

TABLE I.—*The present status of the four patients now in this hospital with the Parkinsonian residual*[1]

	D. W. McD.	J. H. B.	G. W. S.	F. C. G.
Altered reflexes	Positive	Positive	Negative	Positive.
Pupil changes	Negative	Negative	do	Do.
Paralysis	do	do	do	Negative.
Lethargy	Positive	Positive	Positive	Positive.
Diplopia	Negative	Negative	do	Negative.
Tremor	Positive	Positive	do	Positive.
Babinski	Negative	Negative	Negative	Negative.
Parkinsonian	Positive	Positive	Positive	Positive.
Radicular pain	do	Negative	do	Negative.
Headache	Negative	do	do	Positive.
Rash	do	do	Negative	Negative.
Rigidity	Positive	do	Positive	Positive.
Confusion	Negative	Positive	do	Negative.
Nystagmus	do	Negative	Negative	Positive.
Ankle Clonus	do	Positive	Positive	Do.
Atrophy	do	Negative	Negative	Negative.
Twitchings	Positive	do	Positive	Do.
Euphoria	Negative	Positive	Negative	Positive.
Hypotonia	Positive	Negative	do	Negative.
Illusions	Negative	do	do	Do.
Cerebellar symptoms	do	do	do	Do.
Urine retention	do	do	do	Do.
Convulsions	do	do	Positive	Do.
Cephaloptosis	Positive	Positive	do	Positive.
Greasy face	do	do	Negative	Negative.
Dysphagia	Negative	Negative	Positive	Do.
Chorea	do	do	Negative	Do.
Romberg	do	do	do	Positive.

[1] A fifth patient is in the acute stages of the disease.

All four of the above patients are awaiting medical survey.

TABLE II.—*Signs and symptoms in the Mare Island series of cases*[1]

Signs and symptoms	Per cent	Signs and symptoms	Per cent
Headache	60	Twitchings	19
Altered reflexes	54	Excitement	19
Cephaloptosis	38	Stupor	19
Tremor	34	Nystagmus	15
Diplopia	34	Irritability	15
Nervousness	30	Delirium	11
Weakness	30	Delusions	11
Parkinsonian syndrome	30	Conjugate deviations	11
Lethargy	30	Restlessness	11
Pupil changes	26	Radicular pain	7
Rigid neck	23	Contractions	7
Poor memory	23	Arthritic involvement	4
Ptosis	23	Chronic manifestations of chorea	4
Blurred vision	23	Dysphagia	4
Vertigo	23	Confusion	4
Sensory changes	23	Convulsions	4
Paralysis	23	Reversed sleep	4
Rigidity	19		

[1] No attempt is made to classify the clinical types.

It must be kept in mind that not every case chart on file gave a complete and sufficient history of physical findings of the case; if so, the above figures might have been different.

TABLE III.—*Signs and symptoms in the Weinberg series of cases* [1]

Signs and symptoms	Per cent (approximate)	Signs and symptoms	Per cent (approximate)
Alteration of reflexes	98	Myoclonic movements	21
Pupillary changes	72	Cerebellar symptoms	20
Paralysis or paresis	72	Meningeal symptoms	20
Lethargy	68	Retention of urine	20
Diplopia	53	Fundus changes	18
Tremor	52	Reversed sleep	18
Babinski sign	48	Psychoneurosis	18
Parkinsonian symptoms	42	Convulsions	17
Radicular pain	42	Hyperidrosis	15
Headache	40	Cephaloptosis	15
Rash and desquamation	36	Endocrine gland changes	15
Rigidity	36	Greasy face	15
Confusion	35	Dysphagia	13
Nystagmus	35	Choreic manifestations	12
Ankle clonus	35	Spasmodic tic	10
Atrophy	30	Sensory changes	10
Twitchings	30	Contractures	5
Euphoria	26	Conjugate deviations	5
Hypotonia	25	Arthritic involvement	4
Illusions and hallucinations	21		

[1] An exact copy of the table given by Doctor Weinberg.

TABLE IV.—*Mare Island series*

Number	Chief complaint	Wassermann	Globulin	Cells	Course
1	Dizziness	Positive	Increase	23	Died.
2	Fever and sore throat	Negative	(1)	30	Discharged.
3	Posterior neck sore	do	Increase	80	Duty.
4	Cold in head	do	do	18	Do.
5	Dizzy	Positive	do	2	Died.
6	Cervical pain	Negative	do	2	Do.
7	Headache	do	do	2	Do.
8	Stiff neck	do	(1)	180	Transferred.
9	Headache	do	Increase	105	Duty.
10	do	do	do	22	Do.
11	do	do	Decrease	8	Do.
12	do	do	Increase	10	Do.
13	do	do	do	(1)	Do.
14	Weak and drowsy	do	do	25	Do.
15	Posterior neck pain	Positive	(1)	(1)	Discharged.
16	Headache	Negative	Increase	645	Do.
17	do	do	(1)	(1)	Leave.
18	do	do	Increase	360	Died.
19	Pain in chest	do	(1)	(1)	Transferred.
20	Headache	Positive	Increase	41	Duty.
21	Tremor	Negative	(1)	(1)	Transferred.
22	Weak and nervous	do	Decrease	9	Do.
23	Poor vision	do	do	(1)	Remaining.
24	Tired	do	(1)	(1)	Do.
25	Weak; poor vision	do	(1)	(1)	Do.
26	Headache; left eye	do	(1)	(1)	Do.
27	Headache; eye pain	do	None	3	Do.
28	Pain and numbness, left side	do	Not taken so far		Do.

[1] Unknown

SUMMARY

Number of cases, 28.

Duration of period ocvered in files, 12 years. This represents the total number of cases of encephalitis lethargica at this station in that number of years.

Number of cases died, 5. No record is obtainable of the cases discharged as improved or well after leaving here.

Globulin content: Increase, 14; decrease, 3; unknown, 11.

Cell count: Increase, 13; decrease, 3 (all died); unknown, 12.

Wassermann: Positive, 4; negative, 24.

Years of highest incidence of cases, 1918, 1919, and 1925.

Evident relationship to influenza, none.

TABLE V.—*Chief complaint*

Weinberg's series	Per cent	Weinberg's series	Per cent
Pain in chest or extremities	31	Restlessness	8
Diplopia	20	Insomnia	8
Headache	19	Lethargy	8
Nervousness	14	Paralysis	8
Weakness	11	Drowsiness	8
Twitching face	11	Tremor	8

The above are compiled from the case histories of Weinberg's 35 cases.

Mare Island series	Per cent	Mare Island series	Per cent
Headache	48.0	Cold in head	3.9
Pain in and stiff neck	15.4	Poor vision	3.9
Dizziness	11.4	Tremor	3.9
Weakness	11.4	Fever	3.9
Pain in chest	3.9		

It will be seen from this table that the "chief complaints" differ on the west coast from those of the cases of the east coast. The chief complaint in Doctor Weinberg's series, "pain in chest," is in *fifth* place in the Mare Island series, while the most frequent chief complaint, that of "headache," at Mare Island, comes in *third* place in the other series.

TABLE VI.—*Spinal fluid differentiations* [1]

	Color	Cells per cu. mm.	Total protein mg. per 100 cc.	Coll. gold	Sugar
					Per cent
I. Epidemic encephalitis (35 cases).	Clear, colorless.	to 151; average, 34.	25 to 80; average, 54.	44 per cent with reactions.	0.0535 to 0.1130; average, 0.087.
II. Tuberculous meningitis (11 cases).	Clear, colorless.	62 to 325; average, 227.	77 to 500; average, 278.	73 per cent with reactions.	0.001 to 0.041 average, 0.0203.
III. Purulent meningitis (5 cases).	Cloudy	2500 to 13416; average, 6743.	160 to 1320; average, 629.	60 per cent with reactions.	None.

[1] After Wechslar.

TABLE VII.—*Composite statistics*[1]

Number	Age	Per cent	Sex	Occupation	Nativity	Civil status	Mortality
13	1-5, 6-10	1½					
37	11-20	4					
136		15.8					
222	21-30, 31-40	25.7	Males, 522, or 60 per cent; females, 342, or 40 per cent.	Practically every known occupation	U. S. A., 45 per cent; foreign, 55 per cent.	Married, 57 per cent; single, 34 per cent; unstated, 9 per cent.	Died, 21 per cent; recovered, improved, or chronic, 79 per cent.
215	41-50	25					
140		16.2					
72	51-60, 61-70	8.3					
23	70 or above	2.8					
8		.7					
866		100					

[1] After Wechslar.

Other facts: Pregnancies, 22. Familial incidence: 5 instances of 2 in one family and 2 doubtful cases.

Table VIII.—*Composite statistics*

[Wechslar's classification]

Form	Number	Per cent	Form	Number	Per cent
Lethargic	303	35.0	Cerebellar, ataxic	7	0.8
Parkinsonian	129	15.0	Paraplegia	5	.6
Bulbo-pontine	89	10.3	Thalamic	4	.5
Psychotic and delirious	66	7.8	Catatonic	4	.5
Midbrain and basal ganglia	55	6.3	Apoplectic	3	.3
Myoclonic	44	5.0	Anterior poliomyelitic	2	------
Athetoid and choreic	43	5.0	Posterior poliomyelitic	1	------
Radicular and neuritic	29	3.3	Tabetic	1	------
Meningitic	24	2.8	Pseudobulbar	1	------
Hemiplegic	18	2.1	Optic atrophy	1	------
Myelitis, spastic	16	1.8			
Hemorrhagic	11	1.2		864	------
Convulsive	8	.9			

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BIBLIOGRAPHY

(1) Foster, E., and Cockrell, J. R.: Am. J. Med. Sci., 167; 5; 696 (1924).
(2) Editorial: Atlantic Med. J., Oct., 1924, p. 35.
(3) Foster, H. E.: J. A. M. A., 76; 1300 (1921).
(4) La Port and Rouzard: Compt. rend. Soc. de Biol., 83; 392 (1920).
(5) Bouges, H., Foerster, and Marcandier, A.: Compt. rend. Soc. de Biol., 83; 914 (1920).
(6) Polonovski and Duhot: La Presse Medicale., 31; 60 (1923).
(7) Eskuchen, K.: Zeit. fur d. ges. Neurol. u. Psychat., 16 (1922).
(8) Gilbert, O. O., and Gurd, A. E.: Am. J. Med. Sci., 167; 6; 781 (1924).
(9) Parker, H. L.: J. of Nerv. and Ment. Dis., 58; 1; 1 (1923).
(10) Jelliffe, S. E.: Ibid., 61; 6; 561 (1925).
(11) Neustaedter, M., Hala, W. W., and Baryhaf, E. J.: J. Nerv. and Ment. Dis., 61; 603, *abs.* (1925).
(12) Weinberg, M. H.: J. Nerv. and Ment. Dis., 59 (1924).
(13) Bing, R., and Staehlin, R.: Schweiz. Med. Woch., 52; 6; 142.
(14) Grossman, M.: J. A. M. A., 78; 13; 959.
(15) Barker, L. F., et al.: Am. J. Med. Sci., 159; 3; 337.
(16) Howell, C. M. H.: Oxford Medicine, 61; 81 (1921).
(17) Fife, L. L.: Lancet, 1; 8; 379 (1923).
(18) Hall, A. J.: Ibid., 1; 15; 731 (1923).
(19) Buzzard and Greenfield: "Brain," July (1924).
(20) Tilney: "Encephalitis Lethargica."
(21) Mason and Happ: Bulletin on Epidemic Encephalitis.
(22) Tilden: "Epidemic Encephalitis."
(23) Wechslar: J. Nerv. and Ment. Dis., 53.
(23) Gordon, A.: Ibid., 60; 468 (1924).
(25) Archives Med. and Psychiatry: Pp. 64–69.
(26) Medical Science: P. 110; 313.
(27) Journal of Mental Sciences; 70; 1; 24.

(28) Neurological Bulletin, 1924: Reports on Epidemic Encephalitis.
(29) Therapeutic Gazette: 37; 694; 1921.
(30) British Med. Jour.: 2; 1075.
(31) Medical Press: CXL; 131 (1921).
(32) Homan: "Encephalitis Lethargica."
(33) J. A. M. A.: Vols. 72, 74, 77, 79, 80, 81, 82.
(34) Neurological Bulletin: Vol. 3.
(35) Jour. De Med. de Bordeaux: 94; 731.
(36) Annals de Malven: 17; 438.
(37) Rosenow: Jour. Infect. Dis., 33; 531.
(38) Greenberg: Arch. Neur. and Psych., 1924, p. 64.
(39) British Med. Jour., 1922; p. 1803, ibid., 1923; p. 856.

SOME OBSERVATIONS REGARDING CULEBRA

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During the 1924 winter maneuvers of the combined fleets at Culebra, the U. S. S. *Mercy*, for a period of over two months, was anchored off Culebra Island. As this island has so frequently been used as a base for fleet maneuvers in the past, and will probably be utilized in a similar capacity in the future, it was considered that data concerning it, from a medical and sanitary aspect, might be of interest.

As a means of obtaining this data and of gaining accurate information regarding the inhabitants, their habits, mode of life, environment, and physical and mental status, a native clinic was established ashore.

It was considered that this procedure was the ideal method of obtaining knowledge which could be used to advantage in conserving the health of the Navy personnel exposed to this environment.

A visit to the alcalde and a consultation with the government officials ashore resulted in an enthusiastic support of the project.

The local physician employed by the Porto Rican Government, who has an office on the island, was particularly helpful and suggested that we use his office as our base of operations. He cooperated in every possible way and was instrumental in spreading the word over the island, in order that we might come in contact with a large percentage of the population.

We found the people kindly disposed toward our efforts and grateful for even slight service.

The history of Culebra is in itself quite interesting, and it is considered not amiss to record some data regarding its settlement and development. The island was discovered by Columbus on his second voyage to the New World, in 1494. It lies in latitude 18° 19′ N.

FIG. 1.—WESTERN PART OF DEWEY, SHOWING BASS POND WITH ROW OF SHORE PRIVIES IN FOREGROUND. WATERSHED FOR MUNICIPAL CISTERN IN LEFT BACKGROUND

FIG. 2.—BARRELS ARE USED FOR STORING WATER ON PROPERTIES HAVING NO CISTERNS. THEY FURNISH AN IDEAL PLACE FOR THE BREEDING OF MOSQUITOES

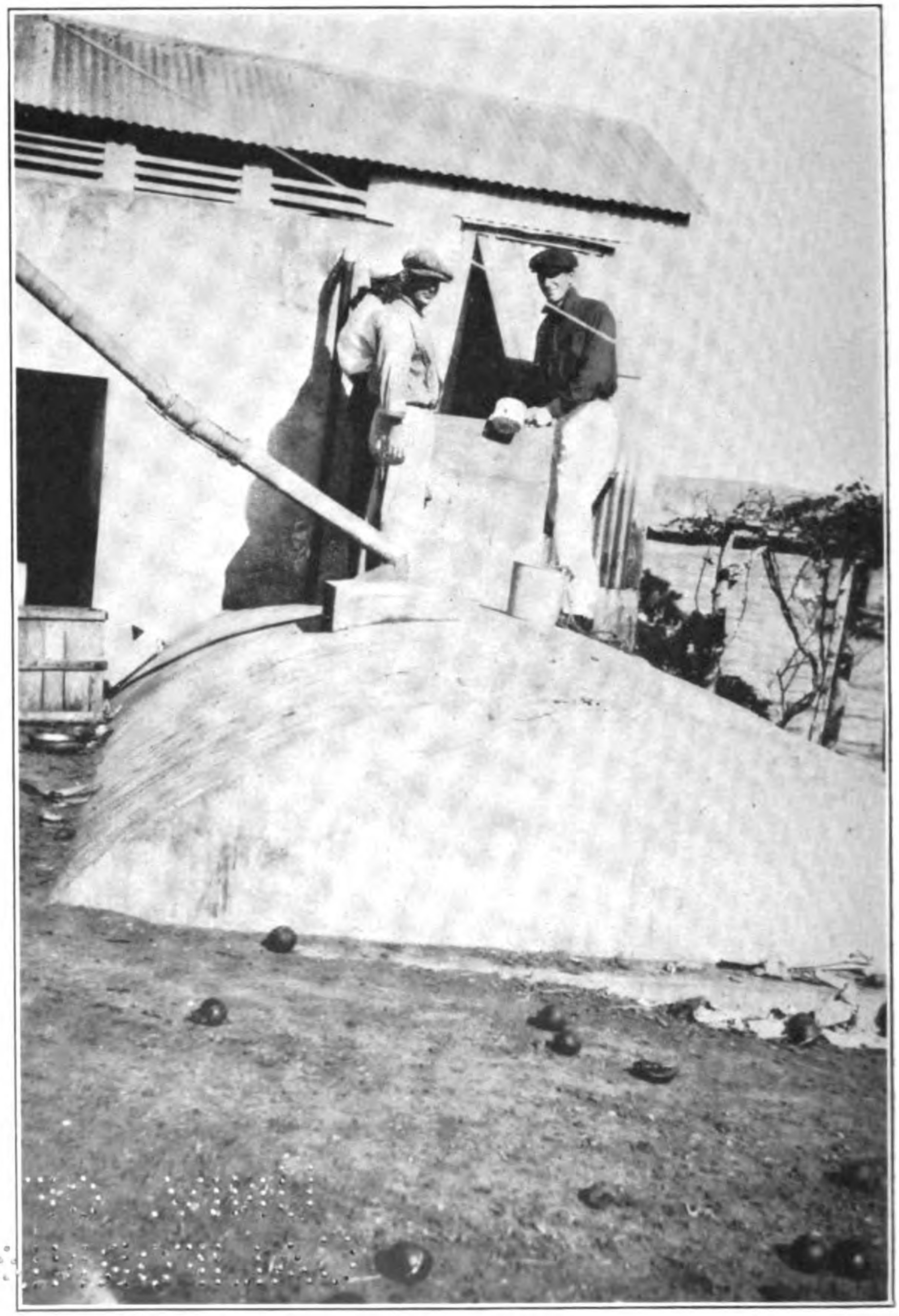

FIG. 3.—AN UNDERGROUND CISTERN IN DEWEY

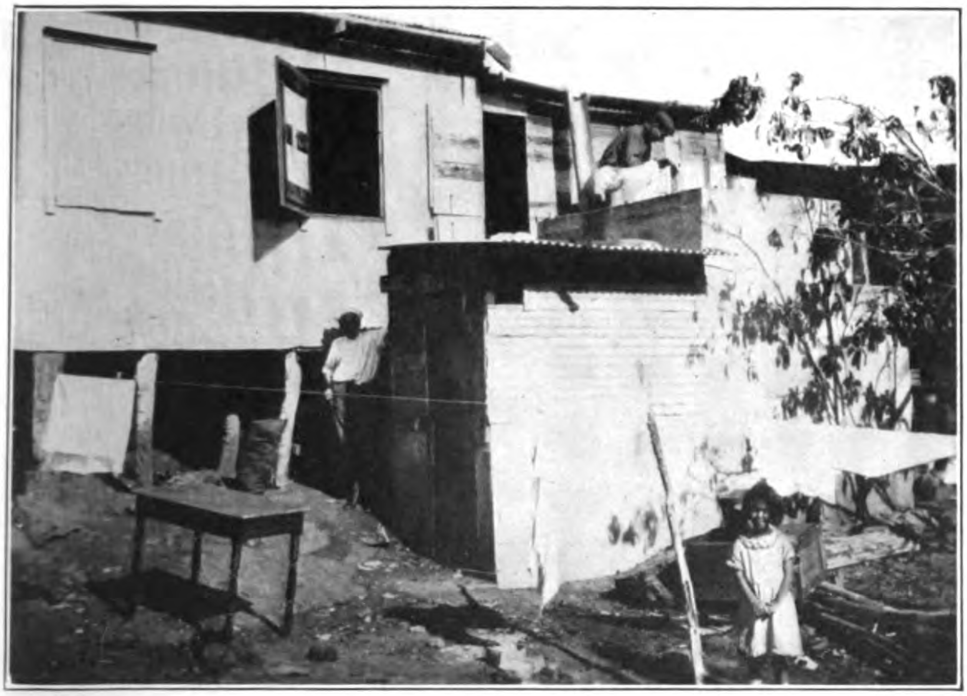

FIG. 4.—CISTERN FOR STORING RAINWATER IN DEWEY. SHED TO THE LEFT IS A SHOWER BATH

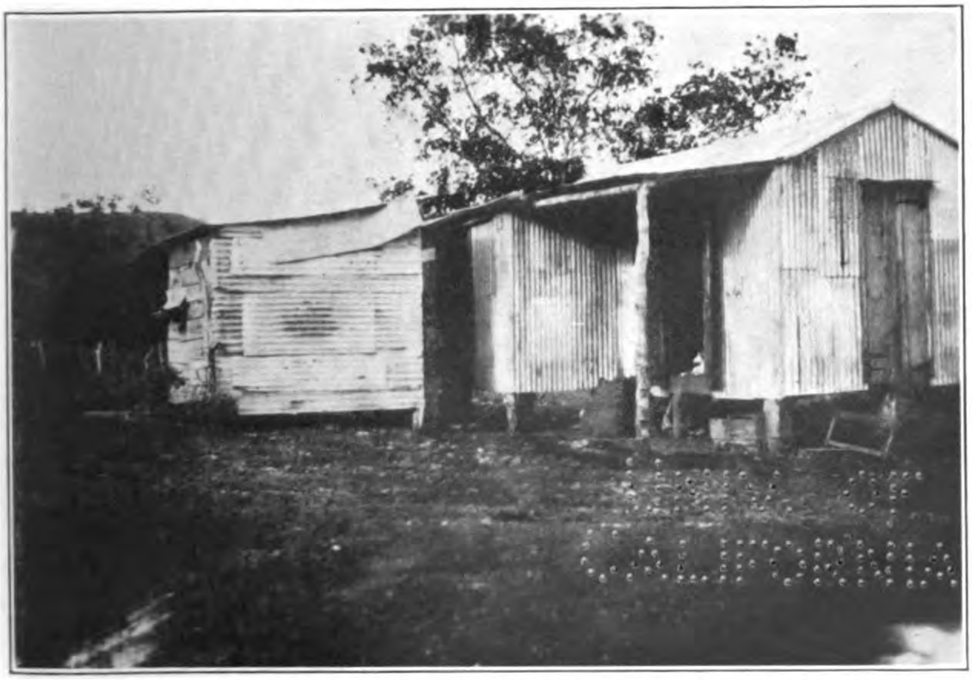

FIG. 5.—A "BETTER TYPE" COUNTRY HOME. KITCHEN TO THE LEFT

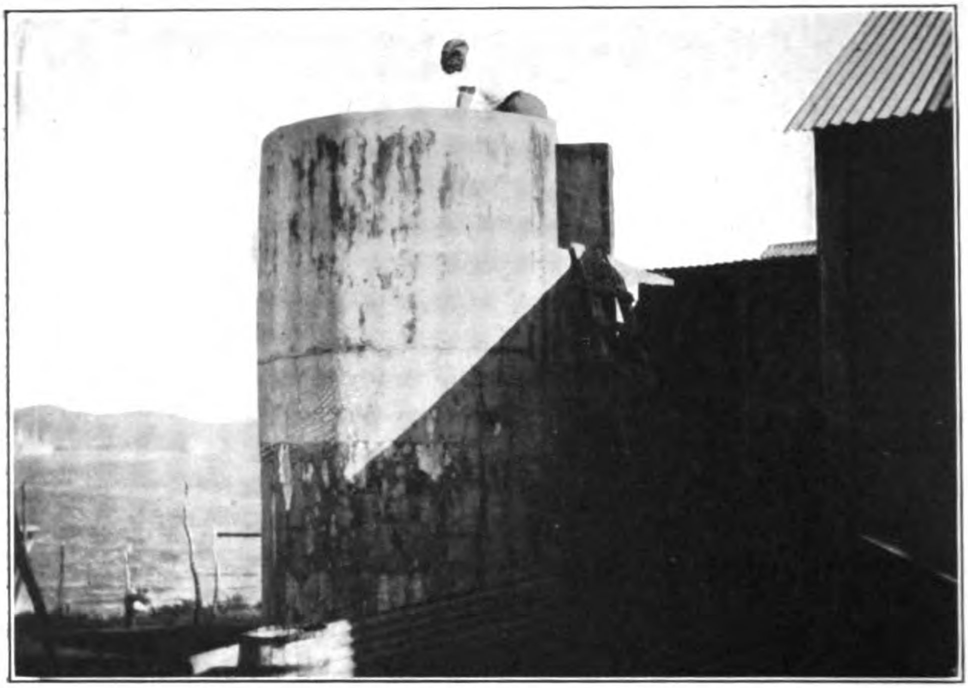

FIG. 6.—TYPE OF CEMENT CISTERN IN COMMON USE

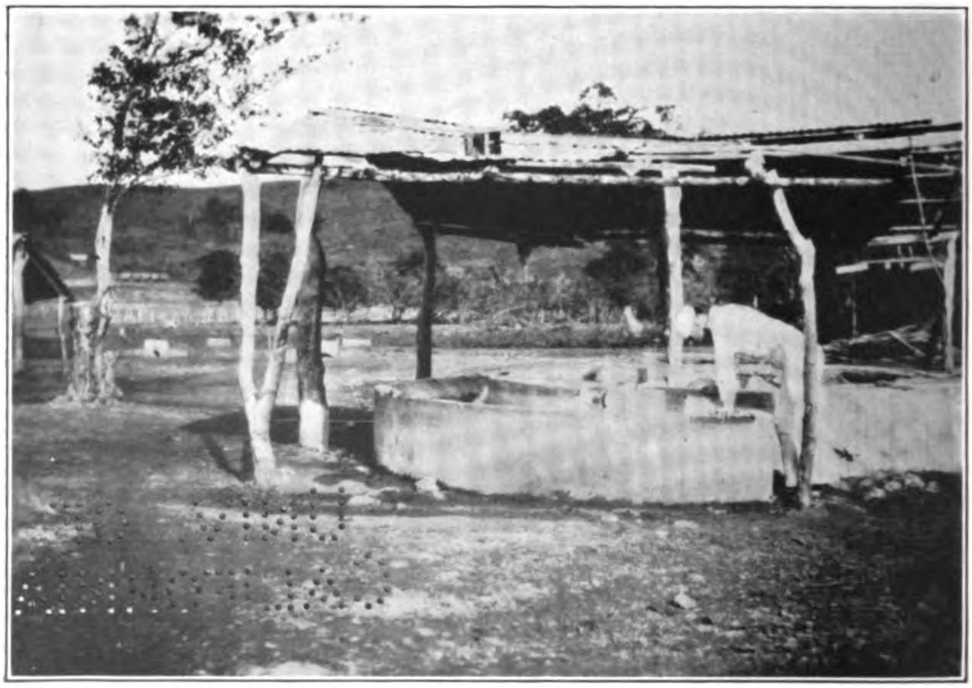

FIG. 7.—WELL AND DRINKING TROUGH FOR CATTLE

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FIG. 8.—THE COUNTRY PRIVY. NO PIT OR RECEPTACLE. SHED MADE OF ODD PIECES OF PACKING BOXES, TIN CANS, AND GALVANIZED IRON

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and longitude 65° 18′ W., about 16 miles east of Porto Rico and 17 miles west of St. Thomas. The island had always belonged to Spain until the close of the Spanish-American War, when it was added to the United States with Porto Rico by the treaty of Paris.

For many years this island served as a rendezvous for pirates, affording safe anchorage and obscure retreat for pirate craft. As a reminder of these stirring times the key in Great Harbor bears to this day the name "Caya Pirata," or Pirate Key.

It is believed by many—and there is much evidence to support the belief—that when Robert Louis Stevenson wrote that marvelous tale of adventure, "Treasure Island," he had in mind the island of Culebra.

The name itself means snake, and whether the island was thus named on account of its shape or because of the appearance of the roots of the mangrove trees which greatly resemble snakes, or because of the complete absence of snakes throughout its domain, still remains in doubt.

Up to 1890, although Spain had made sporadic efforts to colonize Culebra, the results were rather unsuccessful. The neighboring islands of St. Thomas, St. Croix, Viequez, and Porto Rico were in a high state of cultivation, and large acreage of cane, tobacco, and bananas were cultivated, while Culebra, only a few miles away, remained in an uncultivated and more or less primitive state.

In order to encourage colonists, Spain, in 1890, surveyed the entire island of Culebra and divided it into plots of 30 acres each.

She offered these plots to settlers who, upon complying with certain provisos, obtained title to the land.

These provisos required the settlers to clear 8 acres, sow grass, obtain a few head of cattle, and erect a house. Many of these houses were built on the Spanish Crown land at Great Harbor. A small town was thus established, called San Ildefonso.

In 1903, five years after becoming a possession of the United States, the government of Porto Rico granted our Government the use of the island for military purposes.

The following year a naval station was built on the old Spanish Crown land at San Ildefonso, and the settlers at this site found it necessary to erect homes elsewhere.

It appears that the majority of the colonists then moved to two different sites, one at the northeast shore of Great Harbor, known as Roosevelt, and the other on the narrow strip of land between the northwest shore of Great Harbor and Seine Bay, known as Dewey.

Considerable rivalry existed between these two camps, as it was realized that only one would survive. Eventually, owing to its

better site and also to the active influence of some of its politicians, Dewey became the leading town and the seat of the local government.

The present population of the island is approximately 800, of whom about 450 live in Dewey and 50 in Roosevelt.

A preliminary survey of the island from a sanitary standpoint gives one a rather favorable impression. There appears to be a remarkable absence of the "pot belly" of malaria, the anemia of hookworm, the "big leg" of filariasis, and the old indolent ulcers of syphilis, which are commonly seen among the people of the neighboring islands. This appeared rather striking to us in view of the fact that Culebra employs the same primitive methods of water supply, night soil, and garbage disposal, handling of food, and building construction as her neighbors.

Rain water constitutes the main supply of water for drinking purposes. It is collected from the housetops and stored in converted cisterns, barrels, and various other receptacles.

In the town of Dewey there are about 18 cisterns, privately owned. There is one large municipal cistern which obtains its water from a cement watershed on a neighboring hillside.

Most of the families who have no cisterns obtain their water from this source. There is no control of the amount of water each family may take from the municipal cistern. The water supply is sufficient, as a rule, for the needs of the townspeople. At times, however, during severe droughts, many cisterns run dry, and water is begged and bought from the more fortunate ones who have large private cisterns. During one of these dry periods about five years ago a fisherman with business instincts sailed over to Viequez for a load of water. On his return trip, as his boat reached the Dewey anchorage heavily loaded with water, black clouds rolled up, and there came a downpour of rain sufficient to supply the needs of all, thus crushing the hopes of material gain of an enterprising citizen.

There are no wells in the town, but in the country districts there is an abundant supply of well water which is used mainly for cattle. It is somewhat brackish, and the natives do not consider it fit to drink, although some wells are reputed to have good water which has been used for human consumption during periods of drought.

During heavy rainfalls small streams appear in the valleys between the hills, but, with the exception of one, they dry up within a few days under ordinary weather conditions. This permanent creek runs in the ravine east of the naval reservation. It is only about one-fourth mile long and consists of a series of pools connected by small

rivulets. It would appear that this creek drains the ground water of the surrounding clusters of hills. This stream is grossly polluted by cattle, and its water is not potable. It constitutes, however, an important source of drinking water for cattle and, unfortunately, a favorable breeding ground for the Anopheles mosquito, the larvæ of which were found in abundance at this site.

Although cistern water at its best is exposed to various forms of contamination and is not so safe as a piped water supply, it seems that, in Culebra at least, it is a fairly potable water. None of the infectious diseases that are transmitted through a community water supply were seen or heard of. The absence, particularly, of typhoid fever, bacillary dysentery, and other bacterial dysenteries, seemed especially important.

In the town of Dewey two types of privies are used, the shore and the pit privy. The shore privy is built at the water line and depends upon the tide for removal of the excrement. It is used on all properties along the shore of Great Harbor and Bass Pond. There are no shore privies along the water front of Seine Bay, a fortunate condition which should arouse the gratitude of visitors since it makes it possible to go swimming at the beach of this bay without having one's sanitary conscience troubled. The pit privies are used on the properties having no water front. Reliable citizens state that the pits are never emptied and that although some are known to have been used for over 10 years, the fecal level has remained well below the danger line. Our inspection of several of these privies revealed no evidence which in any manner led us to doubt the accuracy of this piece of sanitation history. We had almost accepted as a fact the automaticity of the Dewey night soil removal when one morning we discovered that the pit privy in the yard adjoining the clinic had changed location. The new pit had been dug about 2 feet away from the old. It had been crowned with a concrete frame on which the old superstructure of box wood and assorted pieces of tin cans rested securely. Our interest in this new development led us to interview our neighbor, but, although we persisted and yet used all the tact of which we were capable and which a matter so private demanded, we failed to establish clearly whether the site had been changed because the owner had found the old pit a nuisance or because he had taken our inspection as a sign of displeasure on our part. Our disappointment in being unable to establish clearly the facts was made less acute by the knowledge that we could still believe that there was no urgent indication for a new system of night-soil disposal. However, it should be recorded that our enthusiasm for the simplicity of the Dewey system did not blind us to the more apparent deficiencies. We noted that the town aroma

had an unmistakable admixture of gases usually associated with the fecal excretions of the human body. We further observed how a water front, not lacking in natural beauty, had been despoiled by shabby sheds which, although serving a necessary utilitarian function, had robbed the town of much of its charm.

Among the people scattered in the hills the problem of night-soil disposal hardly seems to exist. Some have a shed with a seat but no pit, while to others the need for such shelter has not yet become apparent.

The town of Dewey boasts of two municipal street cleaners whose duty it is to keep the streets presentable and to empty such receptacles for garbage as are placed at the house front. No covered garbage cans nor any particular type of receptacle is required.

The average type of dwelling in Dewey is a rough frame structure of pine boards covered with a roof of galvanized iron. No plaster is used on the walls and practically every house has a floor of wood, although some of the rural houses are constructed of palm leaves and have hard dirt floors. Most of the houses have no windows, but merely shutters to keep out the rain. There are no inside rooms, in that every room has an outside opening of some sort. Each house, as a rule, has a small adjoining shed which serves as a kitchen. The kitchen facilities are usually limited to one or two charcoal pots.

Adjoining a few houses, shower baths, connected with the cisterns, had been installed. Overcrowding was a common fault of these houses, as families are large and often more than one family live under the same roof. A family of 8, 10, or even 12 children is the rule. In order to provide sleeping space for all members of the family, resort is had to the folding cot and to hammocks of burlap.

The climate of Culebra, as a rule, is quite delightful, there being only slight variations in temperature the year round and only a few degrees diurnal variation. The temperature varies from about 77° to 85°, in the shade. There are rarely any oppressive days, the balmy breezes of the trade winds serving to disperse the body heat. There is no definite rainy season such as obtains in the Philippines, although the rainfall is somewhat greater from July to January than during the rest of the year. These months constitute the so-called hurricane season although, fortunately, these storms occur but rarely, the last one being in October, 1916.

Although the statement is frequently made that mosquitoes are not present in any great numbers, a careful survey of the mosquito situation ashore does not bear out this point. All the cisterns examined showed the presence of numerous larvæ in spite of the fact

that every cistern owner had made more or less successful attempt at screening. The larvæ universally found in the cisterns, barrels, and rain-water storage receptacles were those of Aëdes. The problem of eradicating Aëdes larvæ from the cisterns has never been brought up, as there is no history of yellow fever ever having been present on the island and, in view of the effective quarantine measures now in force, this question may never arise in the future. Should it become necessary, it would involve a system of sanitary supervision and persistent and long-continued work of screening, oiling, introduction of mosquito fish, and education.

It appears likely that screening against the adult mosquito is not sufficient to prevent infestation of the cistern. Quite probably the eggs of the adult mosquito are laid in the eaves or sagging gutters to be washed into the cistern at the next rain. It is quite possible that the eggs can withstand drying for periods of several days. We were led to make these observations after finding several well-screened cisterns teeming with larvæ. This in turn raises the point as to whether filters of sand or charcoal might be an effective barrier against the egg.

Culex mosquitoes were captured on the water front and also aboard ship, which was anchored about 300 yards from the beach. The brackish-water pools along the water front also harbored larvæ from these mosquitoes. It appeared that oiling these pools, which were generally fairly small, would be effective and this procedure was carried out with success.

Anopheles larvæ were found in only one place on the island, in the fresh-water stream east of the naval reservation which we have described previously. They were found at this place in abundance and along the entire stretch of this creek. No adult Anopheles were seen and none were caught in the adjoining marine camp. Eradication of the Anopheles from this stream would involve clearing away all weeds and grass from the bottom and banks before any oiling or mosquito fish could be effective.

Flies did not appear to be a serious nuisance or menace to health. This may be accounted for by the lack of suitable breeding places. We found no manure or refuse piles, and the latrine pits were, as a rule, too wet to provide good incubators for the fly. This fortunate fact may account in some measures for the absence of typhoid, paratyphoid, and dysentery infection in this locality. With an abundance of flies and the close proximity of kitchens and outhouses, fecal contaminations would become common. However, it must be kept in mind that any encouragement offered the fly in the way of exposed manure, garbage piles, or open latrines would probably result in such an increase in the flies as to constitute a serious menace.

The general health of the inhabitants of Culebra was found to be very good. In fact, it appeared to us to compare favorably with that of the average small community in the United States. Due to its favorable location in the tropical zone, its isolation from big centers of population, and its rather limited communication with surrounding islands, the danger of scarlet fever, diphtheria, or measles appears remote. Due, probably, to its remarkable climate, acute respiratory infections are infrequent.

Tuberculosis does not constitute a serious problem on the island; in fact, of the three cases of active pulmonary tuberculosis discovered at the clinic, two cases came from neighboring islands. As indicated above in connection with sanitation, the serious diseases common to the islands in this latitude were not found, such as filariasis, dengue, malaria, sprue, pellagra, and schistosomiasis.

The intestinal parasites most frequently encountered were trichuris, and while these parasites are commonly regarded with complacency, it is our opinion that not infrequently they do constitute a menace to health. Inability to dislodge the whip worm from the intestinal tract, however, deprives one of the evidence which a therapeutic test would give.

In an examination of approximately 200 stools, hookworm ova were found in only five cases, or less than 3 per cent. The low incidence of hookworm disease is probably due to the topography of the island, which allows very little water to collect in pools, and to the excellent drainage into the sea.

Two cases of *Strongyloides stercoralis* were found, which, however, were free from symptoms.

No schistosomiasis was encountered on the island, although special effort was made to discover such cases.

No ascariasis was discovered in this series of examinations.

Food deficiency diseases appeared to be rare. Rickets was not encountered, although the diet of many of the children favored its development. The custom of allowing all children to go about without clothing, and thereby absorb the antirachitic ultraviolet rays of the ever-present sunshine, is obviously the reason for the striking absence of this disease.

Pellagra does not exist on this island and this fact is of interest in view of the fact that once a week beef is killed and distributed generally for immediate consumption. This constitutes the chief supply of animal protein and we may thus infer that the ingestion of fresh beef once a week is sufficient to prevent the development of pellagra, if we accept Goldberger's opinion as to the etiology of this disease.

The absence of scurvy and beri-beri would indicate that the dietary was not deficient in that respect.

The dietary of the average household includes Garabanza beans; navy beans; rice; milk; coffee; beef, usually stewed; pork; fish, baked, stewed, or in soup; boiled chicken; tomatoes; tubers resembling irish potatoes; practically no bread; bananas, raw and fried; coconuts; and, occasionally, oranges. The above list, however, contains some items which are used only occasionally.

The principal fish include the barracuda, grouper, skipjack, spanish mackerel, king fish, and red snapper.

Longusta are plentiful, but seldom eaten by the natives.

The barracuda appears to be one of the most commonly caught fish and appears to be the one about which the greatest difference of opinion exists. It is classed by some writers among the poisonous fish, by others in the doubtful class, and by still others as a perfectly safe food.

A fishing party from the U. S. S. *Mercy* made a catch of three barracudas ranging in weight from 8 to 15 pounds. The question whether or not this fish could be eaten with safety came up immediately. Local fishermen informed us that barracudas are eaten by the natives, although some say that the big ones are not good to eat. In the wardroom, some stated they had eaten barracuda many times and suffered no ill effects and yet they had heard that barracudas were sometimes poisonous. Others had heard that barracudas around Key West were safe food fish but that around these islands they were poisonous and that this was due to their peculiar habit of feeding on coral banks. Another group, equally well informed, told us that during the spawning season only was the barracuda poisonous. Somewhat confused we referred to our library and, to our disappointment, we found that the writers on poisonous fish had not settled the status of the barracuda. All referred to reports of barracuda poisoning and admitted that apparently it is sometimes poisonous. Gatewood, in Naval Hygiene, offers the explanation that the poisonous barracuda is a diseased barracuda. After some serious deliberation we decided to take the stand that the barracuda in good health is not a poisonous fish, and, to defend our opinion, we assumed that all cases of barracuda poisoning reported in the literature and in the wardroom were due either to disease or post-mortem change. It was not without apprehension that we faced the baked barracudas at the dinner table the following day. Although the meat of the large ones is somewhat coarse and dry, everyone agreed that they made a good meal and all took a generous helping. Nothing unusual happened during the subsequent hours of digestion and assimilation—a fact which we noted with the greatest satisfaction.

During the month of January barracudas were eaten on three occasions in the wardroom of the U. S. S. *Mercy* without anything

but digestive comfort. The largest barracuda caught and eaten weighed 26½ pounds. In all instances the fish were gutted within from two to four hours after being caught and then kept frozen in the refrigerator until prepared. No fish was kept more than 24 hours. Although refrigeration to the point of freezing may be a desirable method of keeping fish, we believe that when on ice gutted fish can safely be kept for 24 hours. During our stay at Culebra officers from various ships told of having eaten barracuda, but no report or rumors of barracuda poisoning reached us. In view of the fact that the barracuda is an important food fish in many parts of the world and a fish frequently caught in the fleet, it becomes important to establish the facts in regard to the poisonous qualities of these fish. It would seem that there are two points of particular importance in this regard. First, was the fish in good health? If not, what signs of disease were found? Second, was the fish eaten fresh or was there a possibility of beginning putrefaction instead of true fish poisoning? The warm water and the warmer atmosphere of the Tropics make for rapid deterioration and early putrefactive change in the dead fish.

We suffered no inconvenience from eating barracuda at Culebra over a period of five months.

A warning against the Manchineel tree was published for the information of all hands. It stated: "The Manzanillo Apple is a small green apple and has an apple odor. It is poisonous, sometimes fatal, when eaten, and, when touched, causes a skin irritation. There is one small tree near the Navy canteen on the road to the town of Dewey. There are several trees on the road to Flamingo Beach beyond Flamingo Lagoon." Cattle and pigs will not eat this fruit or stay under a tree bearing it. The natives of Culebra regard this apple as a deadly poison.

The encyclopedia contains the following information about the fruit:

> Manchineel (French Mancenilla), Manzanilla, from Spanish. Manzanillo, dimunitive of Man Zana, Apple, probably from Latin. Matiana (Mala), Matian Apples. A tropical American tree of the family, Euphorbiaceæ. Its acrid milky juice is reputed very poisonous. The tropical American Indians poison their arrows with it. Its perfumed fruit is so acrid as to be inedible.

This was all the information that could be found in the ship's library. In our thirst for knowledge we decided to conduct such experiments as our facilities permitted in order to become more directly acquainted with this dangerous tree.

A sample of apples, leaves, and twigs from these trees were shipped to the Naval Medical School at Washington and referred

to the Department of Agriculture. The following letter was received from the U. S. Department of Agriculture:

The sample of "Manzanilla" apples, leaves, and twigs, which you submitted to Dr. C. S. Butler has been referred to me for consideration and report. The statement which you incorporated in a note pasted to the top of the package containing the sample has been noted. In the memorandum submitted to me by Doctor Butler he makes inquiry regarding the character of the substance found in this material.

Apparently very little, if any, recent chemical work has been done on this material, but the following may be of interest to you. It is official in the Mexican Pharmacopœia as "Mazanilla," which reports that it contains an aromatic substance, crystals of Manzanilla, fixed oil, resin, stearin, gummy material, caoutchouc, and carbon dioxide gas.

The milklike juice from this tree is exceedingly bitter and, when applied on the skin, produces an erysipelatous eruption; internally, it is a violent poison, the same as its fruits. From 10 to 12 seeds have a diuretic effect according to Doctor Ricord.

In this connection the following translation from the Real Enzyklopadie, volume 6, page 359 (1905), is of interest: "The Manzanilla tree grows in tropical America. The milky sap has been used as an arrow poison and in home remedies. It is believed that the reputed poisonous qualities of this plant are exaggerated, however, because a case has been observed where a person has eaten 24 of these applelike fruits without fatal results."

No work has been done on this plant in our laboratory, and I hope that the above information may prove of value to you.

The poison of the Manzanilla apple or the juices of the tree cause an intense but usually transient conjunctivitis when introduced into the eye. This condition has occurred from rubbing the eye when some of the poisonous substance has been on the hands. The onset of symptoms is almost immediate and starts with a smarting and itching sensation, which rapidly increases in severity until within a half hour there is severe pain in the eye, intense photophobia, and marked injection of the conjunctiva. Tears pour from the eyes, the lids become puffy, and the patient presents the picture of intense misery. The treatment consists in washing out the eye with normal saline or boric acid solution, washing the hands, face, and about the eyes with warm water and soap, and sponging off with alcohol. The pain is best controlled with a weak holocaine solution and ice-water compresses to the eyes. In about 2 or 3 hours the symptoms gradually begin to abate. In 12 hours there remains a puffiness of the lids and a conjunctival injection, and usually after 36 hours there is little felt or to be seen to remind the patient of a very uncomfortable experience.

We are indebted to Lieutenant Locy, United States Navy, for the above account of the local irritant action of the sap of the manzanilla tree.

EXPERIMENTS MADE WITH MANZANILLA APPLE

1. *Juice from twig.*—A milky exudate rubbed on unbroken skin of three medical officers, Hakansson, Cook, and Bloedorn, produced no evidence of irritation until the following morning, when a few papules appeared and slight itching.

2. *Juice from rind of apple* rubbed on unbroken skin of left forearms of Hakansson, Ludwig, Delaney, and Bloedorn. Result, negative.

3. *Pulp of apple* rubbed on right forearm (skin unbroken) of Bloedorn, Hakansson, Delaney, and Ludwig. Few papules, slight itching.

4. Injected three drops of *emulsion of fruit* in normal salt solution into the conjunctival sac of guinea pig. Forty-eight hours later there was a definite corneal ulcer which involved the greater part of the cornea. Seven days later the ulcer had disappeared, leaving no scar; eye apparently normal.

Additional experiments are being conducted to show the effect of internal administration of Manchineel, and will be available for a later report.

The original object of our work ashore was to discover, if possible, evidences of Schistosomiasis among the native population. Although we were unsuccessful in this endeavor, it is believed that the additional data secured and the medical aid with which we were able to supply the inhabitants made our clinic ashore not entirely without value.

The natives seemed to appreciate and act upon the advice given them regarding their sanitation, and in many instances modified their dietary so far as it was possible for them to do.

ACTIVITIES AT UNITED STATES NAVAL HOSPITAL, NEWPORT, R. I., DURING THE "MACKINAC" DISASTER

By C. E. RIGGS, Captain, Medical Corps, United States Navy

What is known as "the *Mackinac* disaster" occurred about 5.30 o'clock on the afternoon of August 18, 1925. The steamer *Mackinac* was carrying excursionists from Pawtucket, R. I., and vicinity to Newport and return. The disaster was due to the explosion of a defective boiler while the vessel was proceeding upon her return trip to Pawtucket. At the time of the explosion the *Mackinac* had on board about 700 passengers, many of whom were women and children. The boiler exploded while the vessel was proceeding up the bay, off Coddington Point at the naval training station, and a distance of less than two miles from the naval hospital.

Fortunately, at the time of the accident the ships of the United States Scouting Fleet were anchored in Narragansett Bay. The explosion was observed from the fleet, and motor boats containing rescue parties were dispatched at once to the relief of the disabled vessel. The appearance of these boats speeding toward the *Mackinac* gave assurance to the passengers that relief was coming, and no doubt served to prevent much confusion and disorder among the 700 men, women, and children on board.

The immediate result of the explosion was the loss of two lives; one man was instantly killed in the fireroom and another man jumped overboard and was drowned. There were about 100 others who received scalds of greatly varying severity from the escaping steam. It proved later that 51 of these had received fatal injuries, making a total of 53 lives lost in this disaster.

When the boats from the fleet reached the *Mackinac*, she had been beached and was lying on an even keel. The rescue parties rushed on board endeavoring to remove first those who appeared to be most injured. When from 6 to 10 injured passengers were placed in a boat it shoved off and proceeded with all possible speed to the naval hospital pier.

The first indication at the naval hospital that there had been an accident was the appearance of a motor boat shortly after 6 o'clock, approaching the hospital pier and endeavoring to attract attention by wigwagging and sounding a horn. The officer of the day, Doctor Ebert, directed a stretcher party to go to the pier and hurried there himself.

A boat belonging to the U. S. S. *Milwaukee*, containing six badly scalded women and children, came alongside the pier. Doctor Ebert was told that about 100 more injured were on the way. He sent a message to the office to pass the word for all hospital corpsmen to stand by at the pier with stretchers. The response to this word was prompt. The corpsmen took the first available stretcher from the wards or the emergency rack and ran to the hospital pier.

While the injured were being carried to the hospital, an effort was made to find places in a civilian hospital for as many patients as possible, and it was found that there were no available spaces in any civilian hospital. Ward C, the convalescent ward, was then cleared of its regular patients. These were all ambulatory cases and were transferred to pavilion 4, which had been held in reserve, to be used if needed for emergency expansion. The stretcher bearers carried most of the women and children to ward C and, as a rule, the men were taken to wards B, D, and B-X. After the first treatments had been given, the segregation was completed and ward C was given over entirely to the women and children. The stretcher

bearers worked fast, stopping in the wards only to deposit their patients on the first available beds, and then hurried back to the pier. At the pier the injured were being unloaded so rapidly that there was a constant stream of stretcher bearers coming into the hospital and running back to the pier. Not all of the injured were brought up on stretchers. Some were able to walk, and the children and babies were carried in the arms of hospital corpsmen.

In the meantime word was sent to assemble the members of the staff, nurses, and corpsmen who were off duty. This was done by telephone, and fortunately there was no difficulty in getting a message to the nurses and to every member of the staff. All responded promptly. The same brief message was sent in each case: "There has been a terrible accident; come to the hospital at once." A message also was sent to the commander of the Scouting Fleet saying, "Please send at least six medical officers from the fleet to the hospital. Urgent." Twelve arrived. The Rev. Roy W. Magoun, superintendent of the Seamen's Church Institute and chairman of the Red Cross emergency committee, was notified at the institute.

In ward C teams of three units were organized and began working in a systematic manner. The first unit administered medication; the second removed clothing and put the patient into the bed; and the third applied dressings to the burns. The medication given was noted on the chart at the foot of the bed. In some instances where the chart board contained no chart blank the medication was written in pencil on the chart board. Thus far no names had been taken. The clothing and valuables were put into a pillow case and tied to the bed. The chart board and pillow case containing the patient's clothing were not removed from the bed under any circumstances while the patient was there. If it became necessary to move the patient to a different location, it was carefully seen to it that the chart board and pillow case accompanied him. This method worked satisfactorily and was kept in use until the names and addresses were obtained. There was no instance of any confusion resulting from this temporary arrangement.

It was realized that names, addresses, and the condition of the injured should be obtained as soon as possible in order that proper information might be given promptly to relatives, friends, and the press. Of course none of the doctors, nurses, or corpsmen were available for this work. Fortunately Miss M. I. Mather, of the Red Cross hospital staff, was on the reservation at the time of the accident. Miss Mather was given the task of writing the names and addresses on the chart and sending copies down to the office. She was assisted in this work by Miss E. M. Alexander, Red Cross

hostess, and Miss A. H. Savage, hospital librarian. Later the pillow cases containing the clothing and valuables were tagged and placed in proper custody.

Pharmacist R. N. Cheetham established an information office in the room opposite the officer of the day's office. He received the names, addresses, and other information as it came down from the wards and tabulated the data so that it would be immediately available when needed. He was assisted in this work by Miss L. A. Callis and Miss E. S. Appelgren, of the hospital force, also by Miss H. M. Johnson, a former employee of the hospital, and by Mrs. John Miller, a volunteer helper of secretarial experience. This office was efficiently managed and worked with dispatch. As friends, relatives, and the press began to arrive, they were given promptly the information they required. The information office functioned continually night and day for a period of four days following the disaster.

In the wards it was apparent from a superficial examination of the injured patients that many had received extensive burns that would soon prove fatal. A call was sent out to Newport for the assistance of the clergy. The call received a prompt response and in a very short time practically all of the clergy of Newport were seen about the wards. They administered the consolations of religion to all who sought it. Their presence in such numbers was comforting to all, and the quiet, sympathetic way in which they went about their duties was a further inspiration to those who were hurriedly engaged in relieving the sufferers.

After the injured had been landed, the boats of the Scouting Fleet brought ashore the remainder of the 700 *Mackinac* passengers. These were also landed at the hospital pier. Many of them hastened to the hospital to inquire after injured relatives or friends. Practically all of the others remained on the hospital grounds and many were so unstrung by their recent frightful experience as to be unable to proceed further. The commissary was opened and water, coffee, and sandwiches were distributed to the stranded and somewhat bewildered passengers.

Fortunately for everyone the situation in which the stranded passengers found themselves was soon relieved. Senator Jesse H. Metcalf arranged with the New York, New Haven & Hartford Railroad, by telephone from the hospital office, for a special train to return to their homes in Pawtucket all who wished to go. Senator Metcalf was in the vicinity of the steamer *Mackinac* at the time of the explosion and had come ashore to the hospital with the injured and other passengers. Taxi transportation was provided

between the hospital and railroad station. There were about 20 injured who were able to leave the hospital after their wounds had been dressed. These were taken to the station in an automobile coach and were provided with blankets to be used as wraps. The coach left the hospital just in time to catch the special train which left Newport for Pawtucket at 8.54 p. m.

As soon as the magnitude of the disaster became known in Newport, there were many offers of assistance. The Hon. Mortimer A. Sullivan, mayor of Newport, came to the hospital to do whatever possible. Among other acts of assistance, he provided six members for the nursing staff from the Order of White Sisters. These nursing sisters arrived promptly and their work was invaluable. They remained at their duties throughout the night of the 18th, and after a short rest they returned to carry on their work during the following night.

The local Red Cross responded promptly the evening of the accident with offers of assistance. Mr. G. J. White and Mr. C. B. Judge represented this organization. Mr. White took personal charge of taking the slightly injured from the hospital to the special train. Also, many of the local physicians came to the hospital and assisted until all had received their first dressings. Doctor Baker, superintendent of the Newport City Hospital, sent as many nurses as could be spared. It is estimated that in less than one hour after the arrival of the *Mackinac* victims, 40 trained nurses and 30 volunteer workers were assisting in the wards.

As outside assistance arrived, it was absorbed into the hospital organization without confusion. Those who reported for nursing duty were referred to Miss Esther L. James, chief nurse, who assigned them to work suited to their trained or untrained qualifications. All of them worked earnestly and efficiently, and matters in the wards ran with the same smoothness as if these volunteers had been a part of the permanent hospital force. Miss A. E. Manning, in charge of the Red Cross work of the hospital, reported in the lobby about 7 o'clock and requested to be given some regular duty. She was asked to remain right where she was and was given the very difficult task of directing, advising, and consoling anxious or bereaved relatives and friends. Miss Manning remained almost continuously on this duty for a period of 48 hours.

The disembarkation of the injured from the steamer *Mackinac* was accomplished very rapidly and almost simultaneously. From the time the first injured were landed till all were ashore there was a constant stream of stretchers coming into the hospital. The appearance of the patients at this time was a pitiful sight. In fact, an item in the press described the place as "resembling a shambles as boat

after boat discharged its maimed load." The destructive effect of the live steam was greatest on the exposed parts of the body. In some instances the superficial skin had been torn away completely; in others the skin was hanging in shreds. As the injured were brought in they made various appeals. Some urged to have their clothing removed as quickly as possible; some pleaded for water and some of those who had been scalded most severely made no requests, but were apparently waiting for what they believed to be the inevitable outcome. There were many instances of heroic self-denial. A man and a boy, both fatally burned, were the first patients to enter ward B. The man said to the nurse in charge, "Don't bother about me; look after the boy." A young man in another ward said, "You can do nothing for me; take care of the others." Without exception, the behavior of the patients was brave and heroic.

Under these circumstances it is to be expected that doctors, nurses, corpsmen, and convalescent patients would give forth their best efforts. It is a satisfaction to recall how quickly effective these efforts were. In an incredibly short time all patients were in bed. They had received their first treatments, and temporary dressings had been applied. No audible requests were heard, because at each bedside there was some one to care for any expressed wish. All who sought it were given free access to the bedside of their injured relatives and friends. It was particularly desired and seen to that relatives and friends should have the visible assurance and the consolation that all that it was humanly possible to do was being done for their loved ones. In ward C there was a 15 months' old baby whose mother, father, brother, and sister had received burns that were to prove fatal. The wife of a naval officer remained at the bedside of this baby until 10 a. m. the next day, when she was persuaded to go home for rest.

The manner in which the hospital staff was assembled is interesting. The first messages sent out were to the chiefs of the medical and the surgical services and to the chief nurse. Great care was taken to assure that these messages were delivered correctly and without misunderstandings. Drs. G. E. Thomas and H. A. Tribou answered their telephone calls in person. They started at once and came to the hospital in their own automobiles as quickly as was possible. The chief nurse was notified at the nurses' quarters. The task of notifying the remainder of the staff was then turned over to Chief Pharmacist's Mate G. F. Henry. Drs. D. E. Horrigan and E. H. Dickinson received their messages at the same time and came in automobiles. Drs. C. J. Bucher and H. O. Cozby came in taxis. Dr. F. D. Walker saw the incoming patients from the tennis court and ran to the hospital. Through the courtesy of the secretary of

the Army and Navy Y. M. C. A. a call was sent out for all corpsmen on liberty to return immediately to the hospital.

Near midnight it was realized that rested officer personnel would be needed for the following day. Doctor Horrigan and Dr. C. B. Morse, the dental officer, who was acting as assistant officer of the day, were sent home to sleep. Doctor Cozby turned in at the hospital. Doctor Bucher went home at 2 a. m. Doctors Thomas, Tribou, Walker, and Dickinson remained on duty throughout the night. Doctor Ebert continued his duty as officer of the day till 2 p. m. the next day, when he completed 29 hours' continuous service, most of which was spent in the wards.

To these members of the staff—Doctors Thomas, Tribou, Bucher, Walker, Horrigan, Dickinson, Cozby, and Doctor Ebert, the officer of the day—is due much of the credit for promptness with which the relief work was taken up by the hospital. They also deserve credit for the excellent manner in which this hospital continued to function during the stress of this extraordinary emergency. They met many unusual problems requiring immediate solution. It is a satisfaction to record that they acted with sympathy, judgment, and tact, and that in all the haste nothing was done that had to be undone. Patients, relatives, and their friends felt that all it was possible to do was being done for them, and there were many expressions of gratitude. Besides personal letters of gratitude from individuals, this hospital was commended in letters by the Hon. Mortimer A. Sullivan, mayor of Newport; Hon. Charles H. Holt, mayor of Pawtucket; the Newport chapter of the Red Cross; and the editor of the Providence Journal. The Surgeon General of the Navy, Rear Admiral E. R. Stitt, inspected the hospital the 20th and 21st of August, and desired that an expression of the bureau's appreciation of the splendid work of all officers, nurses, and hospital corpsmen be extended to them.

The conduct of the hospital corpsmen on this occasion received universal and unqualified commendation. They stood the physical strain of hard work and long hours without complaint. Storerooms were quickly opened and supplies reached the wards promptly and in sufficient quantities. The excellence of their work in the wards was frequently commented on by visiting nurses and grateful patients. This unfortunate disaster was an opportunity for the Hospital Corps to demonstrate fully its usefulness for the duties for which its members are specially trained. It is gratifying to note that the intelligence and skill with which they did their work during this unusual emergency measured up to a high standard and confirms an excellent morale.

The assistance afforded the hospital through the cooperation of other naval units was effective and satisfactory. When the commanding officer of the naval training station first received the report of the disaster, he surmised the need of a patrol for the hospital. He sent a patrol of one company in charge of a chief petty officer. The patrol arrived at the hospital prior to the disembarkation of the passengers or the arrival of visitors, and rendered great assistance in directing and controlling the large number of people that were assembling. Chaplain J. J. Brady and Dr. J. B. Moloney, of the training station, arrived early, remained throughout the night, and rendered valuable assistance. Another gratifying instance of the support given the hospital is furnished by the Naval Medical Supply Depot, Brooklyn, N. Y., in the rapidity with which an emergency requisition was filled. During the morning following the disaster it appeared that there would be a shortage of liquid petrolatum. At 9.45 a. m. a requisition was telegraphed to the depot asking for an additional supply of 400 bottles. Before 10 o'clock that evening the requisition had been filled and the article was in the hospital storeroom.

The Red Cross, through Miss Catherine Cottrell, executive secretary of the local chapter, and the Rev. R. W. Magoun, chairman of the emergency committee, demonstrated again the need and usefulness of this organization at the time of any great disaster. In the *Mackinac* disaster the Red Cross promptly filled many wants that could not be met by the hospital. Also, it supplemented the work of the hospital along lines that extended beyond the hospital's jurisdiction. It transferred to their homes in Pawtucket, for further care, certain moderately burned patients when they became able to travel; also, friends and relatives of the injured who were without means were given free transportation; it provided nurses from Newport, Fall River, and Pawtucket for definite periods of time, and these nurses took regular watches; it furnished lodgings in the vicinity of the hospital reservation for those that must remain near by; it provided food and clothing; and sent many telegrams and telephone messages. There was excellent cooperation with the local chapter in Pawtucket. This chapter, through Miss Helen Greenhalge, its executive secretary, received most of the collected clothing and valuables to be returned to their owners. Mayor C. H. Holt, of Pawtucket, was a frequent visitor at the hospital and gave great assistance in coordinating the work of relief.

An acknowledgment of the outside assistance given the hospital would not be complete without mention of those persons, either resi-

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dents of Newport or members of the summer colony, who gave their time and services as individuals as well as through relief organizations. For instance, the large demand for surgical dressings was met through the efforts of a number of ladies who made the dressings at the hospital as fast as they were needed. In consequence of their work, neither nurses nor hospital corpsmen had to be taken from their other activities for this duty. Some assisted in the wards. Through the kindness of these persons the patients received flowers, fruits, ginger ale, and other delicacies that it was impracticable for the hospital to furnish. The efforts of these sympathetic and public-spirited men and women were greatly appreciated by the patients.

A completed census of the severely injured showed that it was necessary to retain in the hospital 59 *Mackinac* victims. There were 24 men, 9 women, 25 children, and one 15-months-old baby. Practically all of these had been so badly burned that at first a favorable prognosis could be given in a few cases only. A description of the condition of the injured as they arrived at the hospital is given by the chief nurse, Miss James, in a letter written shortly after the accident occurred. Miss James wrote:

> I was at dinner when I received the message, "There has been a terrible explosion; have all nurses on duty at once."
>
> The ones who were on duty left the table and went over. The others had to get into uniforms. It was only 15 minutes before we were all there. Even as the captain was telephoning, the boats were at the dock. As I reached the top of the hospital stairs, in came a row of stretchers with the most awful-looking, screaming objects one could imagine. I ran up to the wards.
>
> As men, women, and children were brought in, they were put in the first beds available. In an incredibly short time the place was filled with doctors, nurses, and hospital corpsmen. We dressed as many as could go home and sent them out. The other poor creatures had faces and hands and bodies scalded until they looked as though they had on white masks. Even their eyes were gone. All night it was one mad rush, pouring oil and giving hypodermic injections. It was miraculous how quickly quantities of supplies were brought to us. The corpsmen worked until they were ready to drop; the nurses and doctors the same.

The first death took place at 9.50 p. m., August 18, the day of the disaster. By midnight, 7 had died. During the hour from midnight till 1 o'clock, August 19, 10 died. This was the largest number of deaths to occur during a single hour. There was a total of 26 deaths on the 19th, 4 the 20th, 4 the 21st, 3 the 23d, and 1 the 27th. A 15-months-old baby was transferred to the Newport City Hospital and died there suddenly the following morning. In all there was a total of 46 deaths among the 59 patients admitted to the hospital.

Of the 13 who survived, all received burns that may be classified as serious. Four of these were transferred to their homes after

seven days' hospitalization. Eight patients were sent to the Newport City Hospital for further hospital treatment. The last patient to be transferred for further hospital treatment left September 4. One patient elected to remain in the hospital as a Veterans' Bureau beneficiary and was discharged as cured after 38 days' hospitalization.

The frightfulness of the *Mackinac* disaster can not be forgotten by the survivors nor by those who took part in the relief work. In this disaster the circumstances for prompt relief were unusual and most fortunate. They greatly mitigated the distress and suffering that otherwise would have been experienced. The first important step for the relief of the *Mackinac* victims was taken by the Navy. This was the sending of boats to the disabled *Mackinac*, and many passengers spoke with grateful appreciation of the hope and assurance which the sight of the onrushing boats of the Scouting Fleet inspired in them. Also, the solicitous care of the boat crews in their work of disembarking the passengers was the subject of many grateful comments. The movements of the boats were watched from the fleet, where all stood by to supply additional need. They were gratified to see the disembarkation accomplished without accident or delay. Also, as the boat reached the pier, and the hospital corpsmen with stretchers were seen running across the lawn, it was their satisfaction to know that the first important work of relief had been well done by the Navy.

THE FOOD HISTORY AND PROTEIN SENSITIZATION TESTS IN EPILEPSY

By Lieut. Commander L. H. Roddis, Medical Corps, United States Navy

In an earlier paper[1] the writer has drawn attention to protein poisoning as a cause of illness and shown that much evidence exists that it is an etiologic factor of importance in epilepsy. To stimulate further investigation in this direction it is urged that the food history of epileptics be more carefully studied and their skin reactions to various proteins observed. It is believed that if the proteins to which positive reactions are obtained be excluded from the diet, or the patient desensitized to them, most of the cases of idiopathic epilepsy would be greatly benefited if not actually cured.

Before the food history is investigated, however, the diagnosis should be as unimpeachable as it is possible to make it. Jacksonian epilepsy, convulsions due to uremia, drugs, malingering (in the military service particularly), and hysteria must be excluded. Results can scarcely be expected if the patient is malingering, has hysteria, or some condition other than true epilepsy.

[1] United States Naval Medical Bulletin, July, 1925.

In taking the food history there are a number of considerations of importance. The first is the extremely minute quantity of food substances necessary to produce reaction and illness when susceptibility exists. The skins and seeds of fruit, the coverings of cereals, and certain parts of the organs of animals may contain the protein to which the individual is sensitive. Thus, white bread might cause no trouble, yet whole-wheat bread be a source of illness due to the existence of the offending protein in the covering of the wheat kernel. Flavors or condiments, such as mustard, paprika, pepper, sage, ginger, vanilla, cloves, and cinnamon may be at fault. It seems likely that emanations from animals and the pollen of plants are concerned only with respiratory types of protein sensitization, such as hay fever and certain asthmas, but when these do exist with epilepsy it is probable that attacks of the respiratory condition act as exciting causes of the epileptic seizure.

The threshold at which the attacks may take place varies markedly. Sensitization may be entirely lost, and the patient perfectly recovered for a time, only to become highly sensitized again. A person may be susceptible to a certain amount of protein, as egg albumin, and may be able to eat one egg daily without trouble, but if two eggs are taken an attack occurs. At another time the threshold may be much higher and two eggs may be taken daily, but if custard or some food containing eggs is eaten trouble is precipitated. Fear, anxiety, fatigue, chilling, and the ingestion of irritating foods cause the threshold to be lowered. The patient usually blames the attack on one of these contributory causes, stating that it occurred after a fright, unusual fatigue, sexual excess, or overindulgence in alcohol or some favorite food. Allergic attacks are generally due to some common article of diet, such as bread, eggs, and meats, or more rarely to more uncommon articles which the patient partakes of occasionally or at particular seasons, as certain fruits and vegetables, candy, nuts, or similar things. In studying the food history, the amount taken, its relation to the attack, the contributory factors mentioned in the previous paragraph and the threshold at which trouble arises should be kept in mind.

The study of the skin reaction is of the greatest value. For convenience in testing, the principal drug houses have arranged their food protein extracts into groups so that the number of tests may be reduced. Tests should be made of all food groups, such as meats, eggs, milk, fish, shellfish, fowls, fruits, vegetables, cereals, nuts, beverages, seasonings, and bacteria. If a positive reaction is given to some group, such as meats, it will be necessary to test for each component of the group, beef, pork, lamb, or veal, to determine the prin-

cipal meat or meats causing the trouble. As a practical point, if some more uncommon food group, such as shellfish, gives a positive reaction, the patient may be able to tell whether it was oysters, clams, lobsters, or other sea food that had been eaten.

The technique for the skin test is simple. The skin of the forearm is cleansed with soap and water, alcohol, and ether. A row of scarification points are made, preferably with a vaccine needle, care being taken not to draw blood but only to remove the epidermis. The patient should sit with the forearm resting on a desk or table; the doctor seated so that he has a good rest for his own wrist and forearm. Good oblique daylight for illumination is necessary for the best results, as it is only with good light that the faint yellowish sheen after removal of the outer layer can be distinctly observed. The diagnostic material is applied to the freshly abraded surface with a sterile toothpick. Where liquid preparations of the protein are used the amount that adheres to the broad end of a toothpick is satisfactory. When they are provided in the form of a paste, a piece about the size of the head of an ordinary pin is applied. The material is gently pressed into the scarification. Avoid rubbing with the amplicator, as it increases the trauma and is likely to give confusing reactions in some individuals. The positive reaction appears within a few minutes to half an hour. In a typical positive, a well-defined urticarial wheal will develop. A faint flush about the scarification point may occur, but means only a delicate and readily irritated skin. One of the scarification points should be reserved as a control and inoculated with some of the base used to hold the protein test material. The use of a control gives a definite standard for comparison and results in readings more likely to be free from error than if no such means are employed.

Usually a patient will react to more than one protein, but it will be found that the withdrawal of a single one from the diet is sufficient to lessen the number or the severity of the attacks. If a stormy reaction occurs, it is necessary to remove all foods containing the offending protein or proteins. Simply lessening the intake, however, may be sufficient to check the attacks if the reaction is mild. Experiment in each individual case is the best way to determine the necessity for complete or partial removal of certain foods. If a food is used so extensively in cooking as to make a diet without it difficult to obtain, or, if the response is not satisfactory to a lessened intake, desensitization should be undertaken. The best method is the oral administration of gradually increasing doses of the offending substance. It is well to start with a small dose well diluted; a drop of egg albumin, or of milk, for the first dose, given once a day and

gradually increased until a moderate amount of the food is taken without trouble. It is often difficult to get satisfactory desensitization to foods, and time and patience are required for even moderately successful results. Solutions of various proteins for desensitization may be obtained to use subcutaneously, but, in addition to the trouble and difficulty of taking the hypodermic injections, this method is less satisfactory because the preparation may not contain all the protein in the food substance to which the patient is susceptible. It is of interest to note that desensitization often occurs after bacterial infection and pregnancy.

It is hoped that, in a future paper, results with a number of cases studied and treated by these methods may be described.

CLINICAL NOTES

SEVEN THYROIDECTOMIES

By G. F. COTTLE, Lieutenant Commander, Medical Corps, United States Navy

A study of books written about goiter, of magazine articles, of chapters in textbooks, leaves one stricken with a sense of awe at the enormous literature written on this subject. And yet when confronted by a patient who asks, "Doctor, I have been told I should be operated upon for goiter; what do you advise?" how little does this vast accumulation of knowledge and of recorded data come to the assistance of the surgeon called upon to tell his patient what to do. Of how little value is the classification—adenoma, cystic, colloid. Of what value the magic words "exophthalmic" or "toxic adenoma"? How easily may surgeon or patient be misled into believing the simple thyroid enlargement of adolesence an evidence of serious disease? What symptoms are pathognomonic of hyperthyroidism? Is this rapid pulse, nervous state, slight rise in temperature, loss of weight, early exophthalmic goiter or incipient tuberculosis? Are these slight tremors, slightly bulging eyes, and overacting heart curable by partial thyroidectomy or are these the symptoms of disease not caused by thyroid disease and therefore not susceptible to benefit by surgery? Will the hypertrophied and perhaps decompensated heart in this patient with many of the symptoms found in Graves' disease be benefited by an operation upon the thyroid or will the patient be made worse by the operation?

When the naval surgeon is consulted by patients with these symptoms he can not, as a rule, marshal to his aid a large experience in these conditions among naval patients. Men with goiter do not get by the recruiting officer, and therefore do not often enter the service. If the naval surgeon has seen and treated goiter cases during his internship prior to his entry into the naval service; if at some island possession or at some overseas station he has observed and perhaps operated upon goiter patients, he has gained some knowledge of thyroid diseases and their management. If he has visited one or more of the great goiter clinics in this country or in Europe, where such masters as Crile, Mayo, Lahey, and others operate upon hun-

dreds of these patients, he may feel capable of advising a patient who comes with a thyroid enlargement or the symptoms of hyperthyroidism. If he is on the staff of a naval hospital where reliable basal metabolism observations are possible, and if he has made a study of the technique of surgical treatment of goiter, he may feel that he can with some propriety assume responsibility for the care of these cases when they come to him for advice. Now that Congress has passed laws giving veterans a right to treatment at Government hospitals, the naval surgeon can no longer say, "Let the goiter case leave the Navy and go to a civilian surgeon for advice and operation." If he tries this method, he finds the patient coming back to him in a veteran status asking to be advised and not infrequently asking to be operated upon.

At the United States Naval Hospital, New York, during the year 1925, seven goiter patients were operated upon. These cases were studied carefully before operation and the decision to operate was reached only after thorough consideration of the patient and of his symptoms. In two of the seven cases there were no symptoms of toxicity, no evidence of Graves' disease. Of these, one was an adenoma, the other a colloid goiter. In both the enlargement was mainly in one lobe and operation was decided upon because of the presence of tumor which made these men objects of comment aboard ship. Both were enlisted men of the Navy. Operative removal of one lobe was a simple procedure, involving practically no risk to the patients. They were both returned to their ships apparently cured. The other five cases had toxic or hyperthyroid symptoms of varying intensity.

Among the great number of signs and symptoms said to be due to hyperthyroidism, special search was made in these cases for the following: (*a*) Loss of strength, subjective and objective. (*b*) Rapid pulse, with a systolic blood pressure high in relation to the diastolic. (*c*) Loss of weight, with a good or increased appetite. (*d*) A peculiar motor restlessness which can be described as "purposeless but coordinated movements." (*e*) A basal metabolic rate which remained above normal on three or more repeated examinations while the patient was kept in bed at rest.

The degree of cardiac involvement varied in these cases from slight to severe. Cases 1 and 2 had no hypertrophy and no broken compensation. Cases 3, 5, and 6 had gone on to the stage of hypertrophy with the early symptoms of decompensation. These three cases were found, prior to operation, to have evidence indicative of valvular disease of the heart. All the toxic cases were given a period of physiologic rest in bed and 10 minims of Lugol's solution of iodine

three times a day. These measures lessened the degree of nervousness, lowered the basal metabolic rates, brought down the pulse rate, and permitted a building up of the general physical reserve preparatory to operation.

It was considered important to bring about a definite diminution in anteoperative apprehension. The method of Crile's clinic, where the patient is placed in a quiet room, gradually accustomed to the apparatus and early stages of gas-oxygen anesthesia, and, after a few days, anesthetized and operated upon in bed without letting him know in advance the hour or date of the operation, is an excellent way to save the patient from emotional and nervous strain of anticipation of a severe ordeal. In the wards of the Naval Hospital, New York, such an environment and method of stealing upon the patient unaware was impracticable. The method in use at the Mayo clinic was more easily followed. There the toxic goiter patient lies in a bed in a small ward and sees other patients go to the operating room, return from their operation, and recover in the next bed. This method lessens anteoperative apprehension in a positive manner by building up the confidence of the patient, who then goes to the operating room with a smile. When the period of rest and establishment of confidence in the operating team has brought the patient to a comparatively quiet nervous state, morphine, $\frac{1}{4}$ grain, and atropine, $\frac{1}{150}$ grain, prepares him for the local anesthesia given by the surgeon, or for gas-oxygen anesthesia if a state of analgesia is needed. Each of our toxic patients was told plainly that if he showed any alarming symptoms the operation would be stopped, no matter what its stage, and completed at a later sitting. No promise to complete the operative work at one operation was made. In none of these cases was preliminary ligation performed, though for a time it was thought case 2 might require this precaution.

In case 2, partial thyroidectomy, first of one lobe and then of the other, was performed. In cases 1, 3, and 6, bilateral partial thyroidectomy was done at one operation. In case 5, only the right lobe was removed, because the condition of the patient did not permit a completion of the surgical procedure at that time. Local anesthesia alone was sufficient in all of the seven cases operated upon except in case 5, where it was necessary to use general anesthesia to finish the work. The operative procedure itself need not be described except to say that the standard procedure was followed as closely as possible. No wound complications resulted. No injury to the laryngeal nerves occurred. All operative wounds healed kindly. All were drained for a few days. The postoperative reactions varied from slight to moderately severe. All received water in large amounts both before and after operation. The irritating postopera-

tive tracheitis was relieved by the use of steam inhalations. In none of these cases did the postoperative hyperthyroidism require special measures. In three the postoperative pulse rose to 150 and in case 5 it rose above that because the decompensated heart developed auricular fibrillation. Three of the five hyperthyroid cases returned to work greatly improved, apparently cured. Two cases, 5 and 6, did not do so well. Case 5 had a severe cardiac decompensation following operation, lost weight rapidly, and had a slow convalescence, but several months after leaving the hospital he was reported to be back at work and much improved. Case 6 had an uneventful recovery from operation but, before he left the hospital, began to have edema of the legs and much albumen and many casts in the urine; in fact, he developed a severe nephritis. He became dissatisfied with the medical treatment of his nephritis and left against advice to go to his home. Three months after operation he died of uremia in another hospital. Case 2, a member of the active naval service, after his second operation gained over 30 pounds in weight. At his own request he was permitted to return to active duty in the naval service.

Summary.—Seven cases of goiter operated upon in one year at one naval hospital means that the naval surgeon must prepare himself to meet this condition when he is assigned to a surgical service in a naval hospital. This type of surgical work requires more of the surgeon than a knowledge of how to operate. He should carefully select his cases and use medical as well as purely surgical methods of treatment if he hopes to be able to compare his results with those now obtained in civil hospitals.

ABSTRACT OF CASE HISTORIES

Case 1

McL. J. (ex-F. 2 c., U. S. N.), 47 years old, complained of weakness and nervousness, bulging of eyes. Duration, one year. Weight, 123 pounds. Stated he had lost 30 pounds. Hemoglobin, 85 per cent. B. M. R., + 47 per cent, + 21 per cent, + 25 per cent, anteoperative. Pulse, 120 to 130. Blood pressure, 135/70. Exophthalmos well marked. Slight tremor of hands. Urine, normal. Thyroid, both lobes evenly enlarged and palpable.

Operation, December 2, 1925, double partial thyroidectomy. Postoperative reaction, slight. B. M. R., postoperative, — 13 per cent. Pulse, 80 to 90. Blood pressure, 120/80. Follow up, July 24, 1925. Weighs 155, a gain of 32 pounds. Feels entirely well. Exophthalmos still present. Pathologists report, exophthalmic goiter.

Case 2

Beg. J. (C. E. M., U. S. N.), 34 years old, complained of great weakness, with large appetite, extreme nervousness. Duration, nine months. Weight, 126 pounds. Unable to do his work at sea because of weakness. B. M. R., + 48

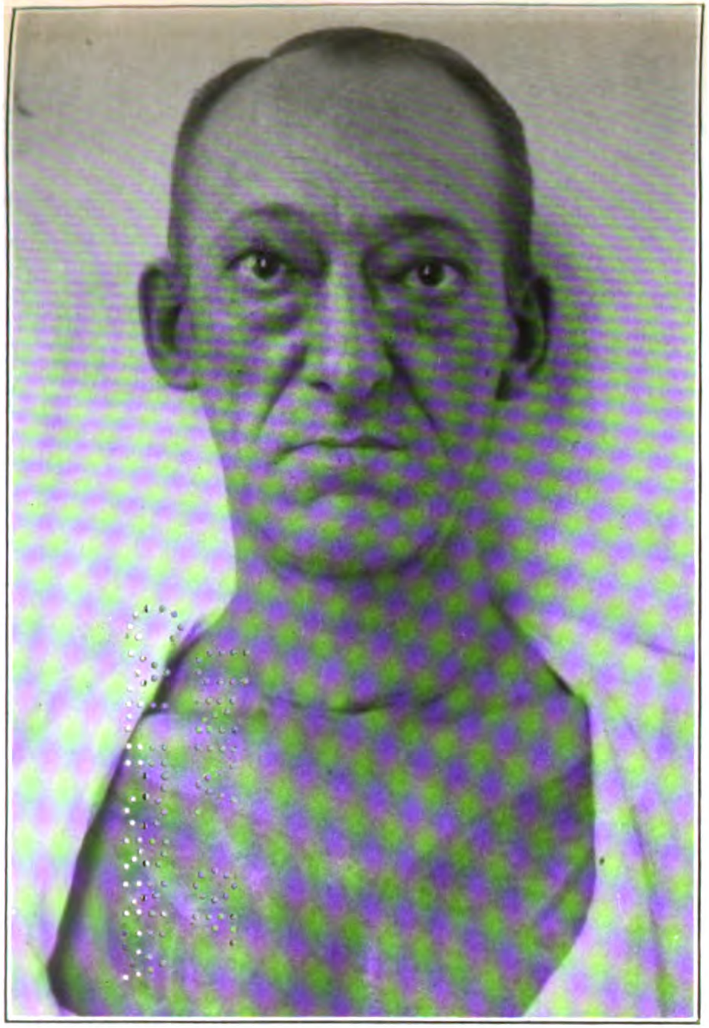

FIG. 1.—CASE 1. EXOPHTHALMIC GOITER. TWO WEEKS AFTER BILATERAL PARTIAL THYROID-ECTOMY

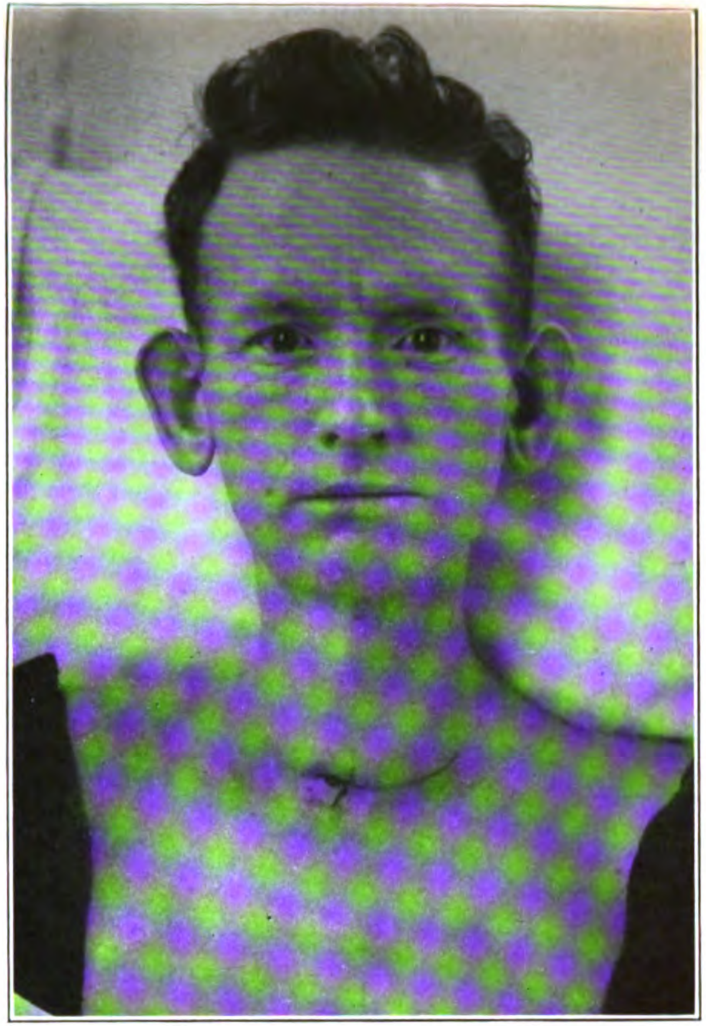

FIG. 2.—CASE 2. EXOPHTHALMIC GOITER. TEN DAYS AFTER RIGHT PARTIAL THYROIDECTOMY. LEFT SIDE WAS REMOVED LATER

FIG. 3.—CASE 3. AFTER DOUBLE PARTIAL THYROIDECTOMY. WOUND HEALING

FIG. 4.—CASE 6. TOXIC GOITER BEFORE DOUBLE PARTIAL THYROIDECTOMY

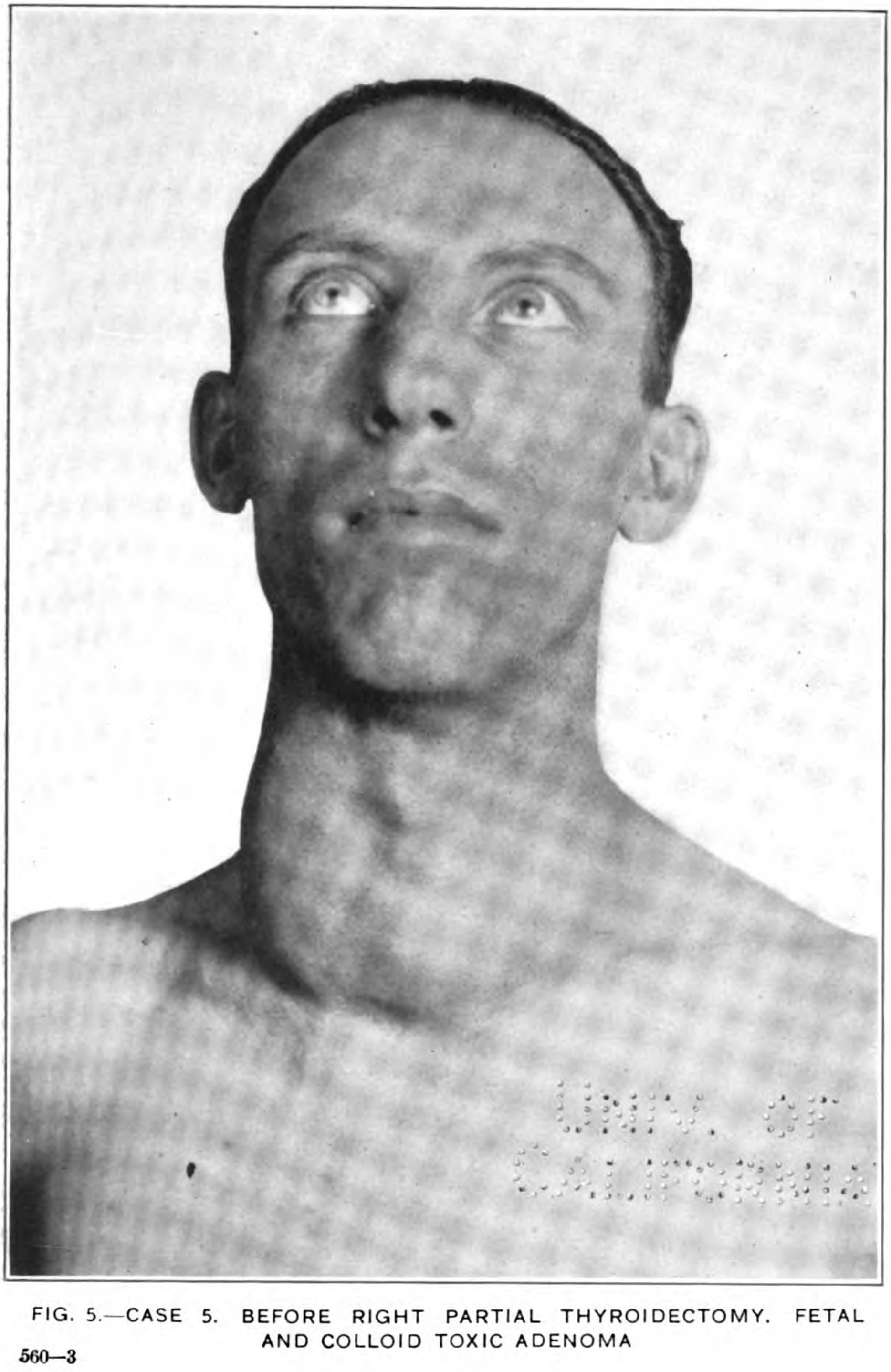

FIG. 5.—CASE 5. BEFORE RIGHT PARTIAL THYROIDECTOMY. FETAL AND COLLOID TOXIC ADENOMA

560—3

per cent, + 37 per cent, + 36 per cent. Pulse, 110 to 120. Blood pressure, 158/82. Marked tremor. Some dyspnea. Thyroid, palpable and visible, somewhat enlarged. Exophthalmos very slight.

Operations, January 28, 1925, right partial thyroidectomy; April 15, 1925, left partial thyroidectomy. Postoperative reaction, slight. B. M. R., postoperative, — 14 per cent. Blood pressure, 138/72. Pulse, 90 to 100. Follow up, July 8, 1925. Weight, 150 pounds, a gain of 24 pounds. Returned to his duty as an enlisted man in the United States Navy. Pathologists report, exophthalmic goiter.

CASE 3

St. L. (veteran), 45 years old, complained of dyspnea, nervousness, palpitation, rapid heart, weakness, and inability to work for two years. Duration of goiter, seven years; of symptoms, two years. Weight, 146 pounds. Heart enlarged. Systolic murmur. Urine, trace of albumen. B. M. R., + 32 per cent and + 28 per cent, anteoperative. Pulse, 90 to 110. Blood pressure, 134/70. Tremor definite. Moist hands. Well-marked exophthalmos. Thyroid, enlarged; right lobe larger than left.

Operation, July 15, 1925, double partial thyroidectomy. Postoperative reaction, moderately severe. B. M. R., post operative, — 6 per cent. Follow up. Left hospital feeling well and ready to return to work. Pathologists report, colloid goiter.

CASE 4

Fol. W. Z. (F. 1c., U. S. N.), 30 years old, complained of dyspnea and weakness on exertion. Tumor in neck, duration six years. Tumor has become gradually larger until now its size interferes with wearing a collar. Right lobe, evenly enlarged about 3 inches by 2 inches. Left lobe palpable; no nodules felt. Blood pressure, 120/50. B. M. R., + 10 per cent and + 9 per cent, anteoperative. Not a toxic case. Anteoperative diagnosis, simple goiter.

Operation, August 12, 1925, right partial thyroidectomy, left lobe not attacked. Pathologists report, simple colloid goiter, benign. Recovery uneventful. After a month's leave, returned to duty aboard ship, apparently cured.

CASE 5

Sch. W. (veteran), 25 years old, complained of large tumor in neck and difficulty in breathing. Duration five years. Weight, 143 pounds. B. M. R., + 42 per cent and + 32 per cent, anteoperative. Pulse, 100 to 110. Blood pressure, 145/50. Markedly nervous. Tremor pronounced. Difficulty in sleeping. Moderate exophthalmos. Urine, albumen and casts. Heart, enlarged and signs of mitral insufficiency, compensated. Many carious teeth. Chronically diseased tonsils. Thyroid large; right lobe 4 by 2 inches; left 3 by 2 inches.

Operation, March 31, 1925, right partial thyroidectomy. Postoperative course, severe reaction with marked mental depression. Decompensated heart ushered in by auricular fibrillation. Loss of weight to 103 pounds, postoperative. Pulse after cardiac compensation was restored, 97 to 105. Blood pressure, 135/60. Left the hospital with marked gain in weight, but not back to anteoperative weight. Follow up, July 24, 1925. Doing odd jobs at painting. A definite gain in weight and strength. Pathologists report, foetal colloid toxic adenoma.

Case 6

Az. T. M. (veteran), 31 years old, complained of goiter, nervousness, heart trouble, and bulging eyes. Had been treated for three years with X ray without improvement. Duration of symptoms, three years. Weight, 109 pounds. Marked weakness, shortness of breath, sweating, headache, history of chronic tonsillitis and rheumatism. B. M. R., + 45 per cent + 24 per cent, and + 19 per cent. Pulse, 110 to 120. Blood pressure, 135/50. Urine, much albumen and many granular casts. Heart enlarged, mitral lesion with some insufficiency, fairly well compensated, but history of broken compensation. Thyroid was visible and palpable. Slight bilateral enlargement. Exophthalmos well marked. Tremor definite.

Operation, February 18, 1925, double partial thyroidectomy. Slight postoperative reaction. Two weeks after operation, felt well and was very hopeful of recovery. Upon getting up and about, his legs began to swell with edema and he was sent to the medical ward for treatment of his nephritis. Postoperative pulse, 80 to 90. Blood pressure, 143/82. He left the hospital against advice. Follow up, April 6, 1925. Died in another hospital two months after operation, of uremia. Pathologist's report, toxic foetal adenoma.

Case 7

Is not reported here in detail because the clinical notes were not found for review. This patient, a chief petty officer of the Navy, had an adenoma. One lobe was removed. Goitre was nontoxic. Result, return of patient to active duty aboard ship.

CHOLECYSTOGRAPHY

Intravenous and Oral Administration of Sodium Tetraiodophenolphthalein

By C. M. Shaar, Lieutenant, Medical Corps, United States Navy

Cholecystography has passed its stage of infancy and now is considered by many workers to be a practical and safe method in the diagnosis of cholecystic disease. Some enthusiastic investigators claim its results to be as reliable as the röntgenological visualization of organic lesions of the gastrointestinal tract with the aid of the opaque meal. The value of this method has been repeatedly demonstrated by Graham, Cole, Copher, and others and the possibilities it offers are considerable.

The technic used at the Boston Naval Hospital is essentially the same as outlined by the originator of the method, except for a few details. In the series we are about to report none of our patients experienced severe reactions as a result of the intravenous administrations of sodium tetraiodophenolphthalein. This has been attributed to the following conditions:

1. The intravenous dose of sodium tetraiodophenolphthalein was decidedly smaller than the average dose used by various investigators and the results were equally satisfactory.

2. Careful preparation and treatment of patients 24 hours before and after injection.

3. The dye was not given to cases with cardiorenal disease or cardiovascular disease or where obstruction of the common duct was suspected or known to exist.

4. All patients were adult males below the age of 54. Graham has found male patients less susceptible to the toxic effects of the dye than female patients.

Sodium tetraiodophenolphthalein appears to be the most popular compound for intravenous and oral administration and is used by most workers in the laboratory and clinic. Whitaker and Milliken, in a series of experiments on animals, have shown that there is no appreciable difference in toxicity of the salts, sodium tetraiodophenolphthalein and sodium tetrabromphenolphthalein. They also demonstrated that the ratio of the opacity of the bromine salt to the iodine salt is approximately 1 to 2. This fact is based on atomic weights: Bromine 80, and iodine 127. Sodium tetrabromphenolphthalein contains 47 per cent of bromine; sodium tetraiodophenolphthalein contains 59 per cent of iodine. The opacity to the Röntgen ray is mainly dependent upon this factor, hence a cystogram may be obtained by using a smaller dose of the iodine salt.

Preparation of Sodium Tetraiodophenolphthalein for Administration

1. Intravenous administration.
2. Oral administration.

Sodium tetraiodophenolphthalein is a compound of blue crystals, readily soluble in water, has a molecular weight of 682, is more opaque to the Röntgen rays than the bromine salt, and is mainly excreted in the bile.

1. *Intravenous administration.*—Each dose is freshly prepared the morning of its administration. The crystals are dissolved in distilled water and made up to a 10 per cent solution, filtered through fine filter paper, and sterilized in a boiling-water bath for 15 minutes. The solution is cooled to body temperature before administration. This may be given with or without the addition of 1.5 cubic centimeters of 10 per cent solution of sodium bicarbonate. We have used both methods and, as we did not see any difference in the effect, the dye is being given at present without the sodium bicarbonate. The dose we have been using varied from 0.025 to 0.04 gram per kilogram of body weight. A dose as small as 0.015 gram per kilogram has been used with some success; it is believed that such a dose is too small for the average case. The best results were obtained by giving 0.04 gram per kilogram of body weight.

2. *Oral administration.*—There are many methods used to obtain cholecystograms by the oral administration of tetraiodophenolphthalein. The various methods aim to prevent precipitation of the salt by the hydrochloric acid of the gastric juice. Menees and Robinson gave the drug with sodium bicarbonate; later they gave it in gelatin capsules hardened by formaldehyde. Palefski used the duodenal tube to administer sodium tetrabromphenolphthalein in an emulsion of acacia. Stewart used a similar tube to inject a solution of sodium tetraiodophenolphthalein into the jejunum. Graham administered sodium tetraiodophenolphthalein in capsules coated with phenyl salicylate, which is not digested in the stomach. The main disadvantage of this procedure is that the phenyl salicylate occasionally does not dissolve in the intestinal tract. Stearic acid is being used for coating pills of sodium tetraiodophenolphthalein in place of salol to avoid poisoning by the latter, as a large number of pills are required for the test.

Dose.—The oral dose given by Graham is 0.07 gram per kilogram of body weight. He recommends 5 grams as the routine dose for an adult.

Preparation of Patient for the Intravenous Administration of Sodium Tetraiodophenolphthalein

Orders given the patient are essentially the same as those given by Graham and Cole. Twenty-four hours prior to the intravenous administration of the dye the patient is hospitalized. A purgative is given, unless contraindicated, and the patient receives liquid diet the day before the injection and 48 grains of sodium bicarbonate every three hours for 48 hours. The morning of the examination breakfast is omitted, also lunch, but the patient may have water and a glass of milk prior to the first röntgenogram, which is usually taken four to five hours after the injection. An enema is given to rid the colon of excess gas, as this condition might interfere with the visualization of a faint shadow due to scanty filling. In the evening the patient is given a nonprotein dinner, and the day after the intravenous injection the patient resumes his usual diet.

Method of Intravenous Administration

The solution is administered intravenously by a three-way stopcock apparatus to prevent the possible injection of the dye outside the vein and irritation and sloughing of the subcutaneous tissues. If the following procedure is followed all possibilities of local sloughing and irritation are entirely eliminated: The needle is introduced into the median basilic vein under strict aseptic precautions. Allow 50 cubic centimeters of sterile normal saline to run

through, to be sure that the needle is in the vein and not in the subcutaneous tissues. Then turn the stop-cock, with the needle in position, and inject the solution slowly, consuming from 5 to 10 minutes, as a rapid injection may cause severe pain and produce toxic symptoms. The injection of the dye should be followed by 100 cubic centimeters of normal salt solution without disturbing the apparatus. This can be accomplished by turning the stop-cock to its original position. If the patient develops any unusual symptoms during the administration, the procedure is stopped immediately. Such symptoms are severe pains in the back and abdomen, flushing, perspiration, nausea, vomiting, palpitation of the heart, and a rise followed by a sharp fall in blood pressure.

The injection is made in the morning about 9 o'clock and the dose given in one injection, as the dose we have been using is much smaller than that usually used.

Röntgenograms are made at the fourth or fifth hour, eighth and twenty-fourth hours, and sometimes at later periods, as might be indicated by the findings.

Oral Administration of Sodium Tetraiodophenolphthalein

The salt is given in doses varying from 0.05 to 0.08 grams per kilogram of body weight. Graham, as has been stated, gives 5 grams as the routine dose for adults. Menees and Robinson advise the administration of sodium bicarbonate, given separately or placed in the capsules, each capsule to contain 0.5 to 1 gram of the sodium tetraiodophenolphthalein. One-third the number of capsules is taken at the beginning of the evening meal, 6.30 p. m.; one-third about the middle of the meal; and one-third at the end of the meal. The object is to distribute the dye in the food and avoid absorption of all the dye at one time. After this meal no food is given until the first and second röntgenograms are taken. The first is taken at 9 a. m. and the second at 1 p. m. the following day. Then a glass of milk or a cup of tea may be given. The third röntgenogram is taken at 5 p. m. and, if necessary, another is made at a later interval. This method is essentially the same as outlined by Graham. The shadow of maximum density is usually obtained 18 hours following the oral administration. Menees and Robinson state:

> The greatest size is usually reached on the 12 to 14 hour film, while the 18 and 24 hour films show a much smaller and denser shadow. Following the food there is usually a distinct decrease in the size of the shadow. For this reason general diet is given following the first films, as it serves to determine the distensibility of the gall bladder.

Reactions have been noted following the oral administration of sodium tetraiodophenolphthalein. Nausea and vomiting occurred more frequently than other symptoms. Diarrhea, headache, and vertigo were also noticed in some cases.

Röntgenological Technique

The exposure is made with the patient on his face. Buckey diaphragm, Coolidge radiator tube, and double intensifying screens are used with a 5-inch spark gap with 30 milliamperes, 20 inches target-film distance, and five to six seconds exposure. Films are taken as stated above.

Interpretation of Findings

The most important points in the interpretation of the findings are the appearance and disappearance of the shadow within certain limits, the character and density of the shadow, its contour, variation in size, mottling, defects, and other irregularities. Absence of the gall-bladder shadow is of great significance. It is indicative of gall-bladder disease provided liver function is not considerably impaired.

The normal gall bladder after an intravenous injection of sodium tetraiodophenolphthalein usually casts a shadow at the third, fourth, or fifth hour. The shadow reaches its maximum intensity between the eighth and eighteenth hour and should disappear at the end of the thirty-sixth or forty-eighth hour. There is considerable variation in the shape and position of the normal gall bladder as shown in Figure 4. After the oral administration the shadow attains its largest size about the thirteenth hour and should disappear at the end of the forty-eighth or fiftieth hour. The normal gall bladder has a uniform density, normal contour, regular outline, and a shadow that increases in density and disappears within a certain period following the administration of the dye. Variation from these findings, in the absence of hepatic disease, is indicative of gall-bladder pathology. Absence or faintness of shadow, delayed filling or emptying, abnormal contour, irregular outline, mottling, and cholecystoptosis should be considered signs of cholecystic disease.

REPORT OF CASES

Thirty-three cases were examined by the intravenous method and 18 by the oral method. Twenty of this number revealed evidence of cholecystic disease while the rest appeared normal. Of the 20 cases showing pathological conditions only 5 were submitted to operation and the findings were proved in every case.

The table following shows some interesting facts with regard to the findings:

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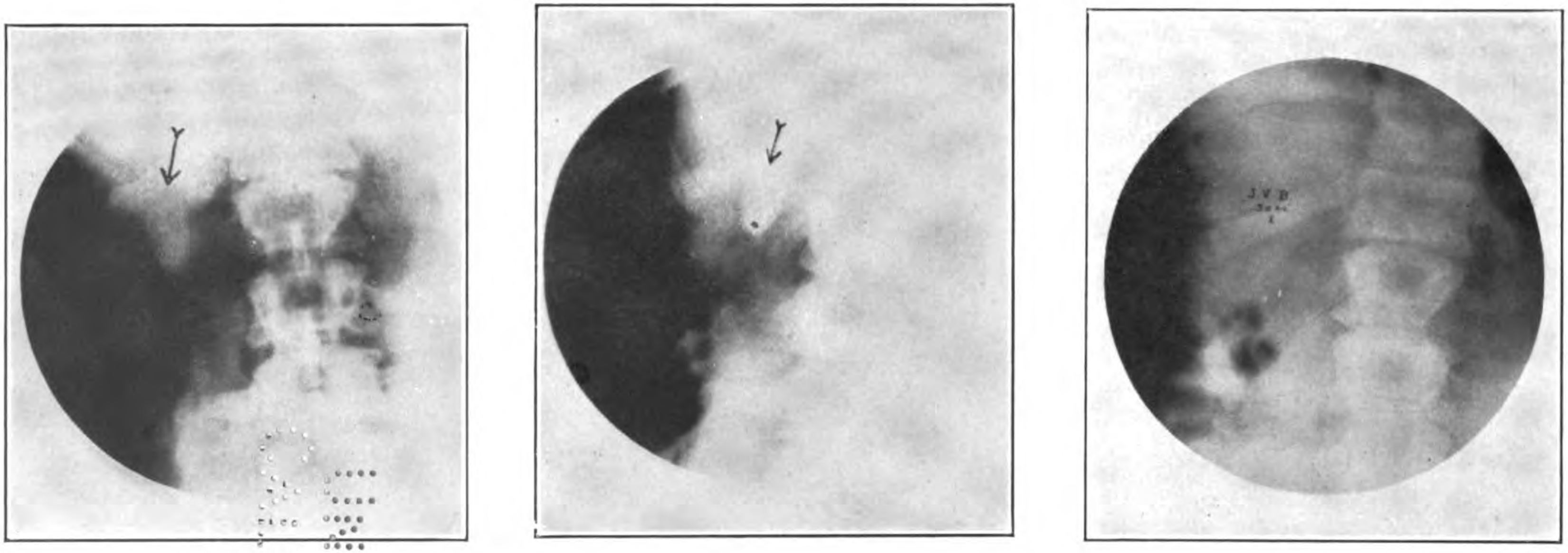
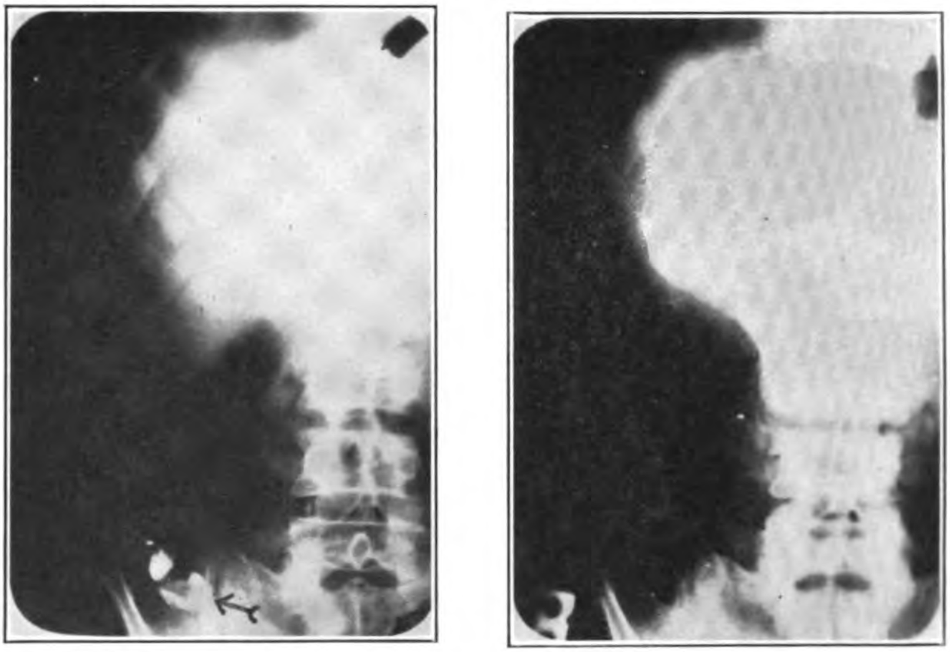


a *b* *c*

FIG. 1.—(J. V. B., VET.) CHOLECYSTOGRAM SHOWING NORMAL RESPONSE TO THE TEST. *a*, FIFTH HOUR; GALL BLADDER WELL VISUALIZED, OVAL, REGULAR IN OUTLINE, HOMOGENEOUS. *b*, EIGHTH HOUR; DENSITY INCREASED, SHADOW SLIGHTLY SMALLER. *c*, TWENTY-FOURTH HOUR; SHADOW NOT DISTINCT



a *b*

FIG. 2.—*a* TWENTY-FOUR HOURS AFTER ORAL ADMINISTRATION. UNDISSOLVED CAPSULES IN CECUM. SODIUM TETRAIODOPHENOLPHTHALEIN IN GELATIN CAPSULES WAS GIVEN. NOTE ABSENCE OF GALL-BLADDER SHADOW. *b*, SAME CASE TWENTY-SIX HOURS LATER. NOTE ABSENCE OF SHADOWS OF CAPSULES AND GALL BLADDER. AT A LATER DATE DRUG WAS GIVEN INTRAVENOUSLY AND GALL BLADDER WAS WELL VISUALIZED.

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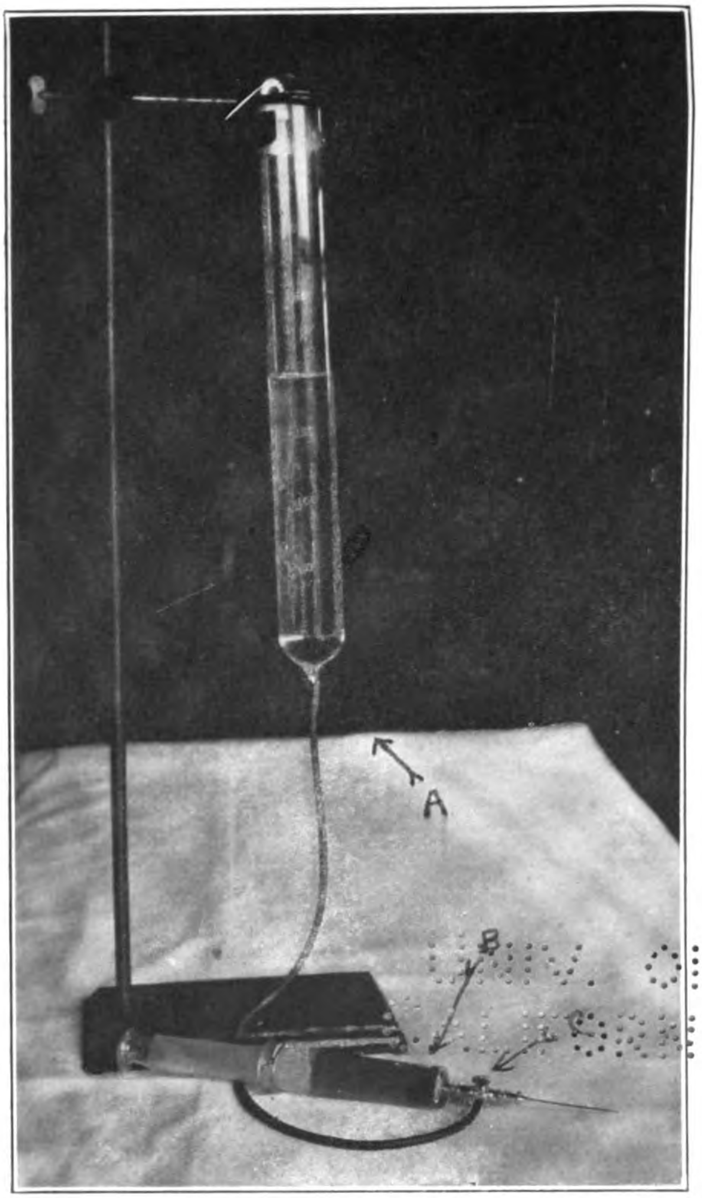

FIG. 3.—APPARATUS USED FOR THE INTRAVENOUS ADMINISTRATION OF SODIUM TETRAIODOPHENOLPHTHALEIN. *A*, STERILE NORMAL SALT SOLUTION. *B*, SOLUTION OF SODIUM TETRAIODOPHENOLPHTHALEIN. *C*, THREEWAY COCK TO FACILITATE ADMINISTRATION AND AID IN AVOIDING LOCAL IRRITATION AND SLOUGHING

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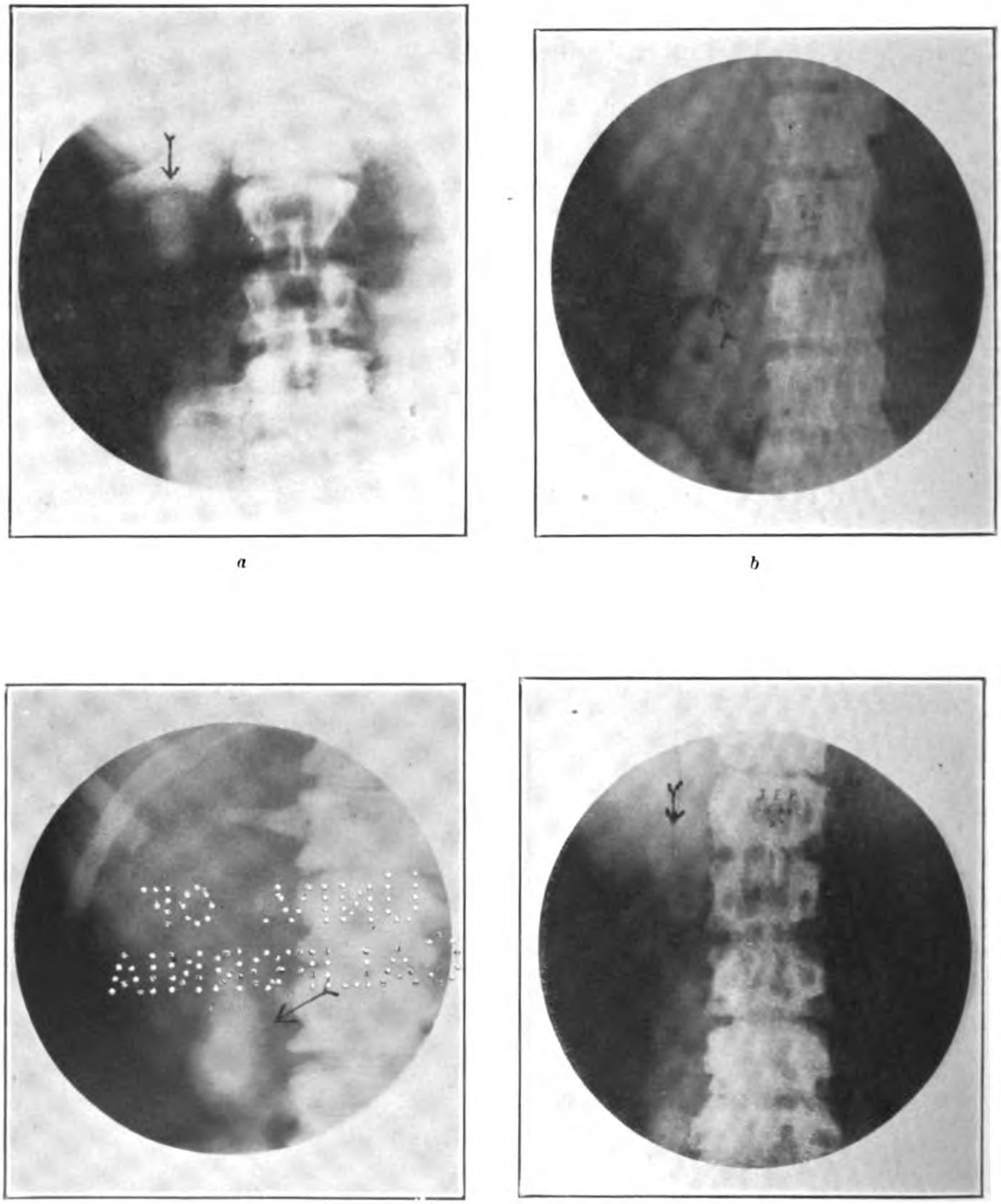

a *b* *c* *d*

FIG. 4.—CHOLECYSTOGRAMS SHOWING THE VARIOUS TYPES OF GALL BLADDERS AS TO SHAPE AND POSITION

a, (J. V. B., Vet.) Gall bladder *oval* in shape. *b*, (F. S., Vet.) Gall bladder ***tubular*** in shape. **c, (W. M., U. S. N.)** Gall bladder *pyriform* in shape; marked cholecystitis. *d*, (J. E. P., Vet.) **Gall bladder** ***angular*** in shape

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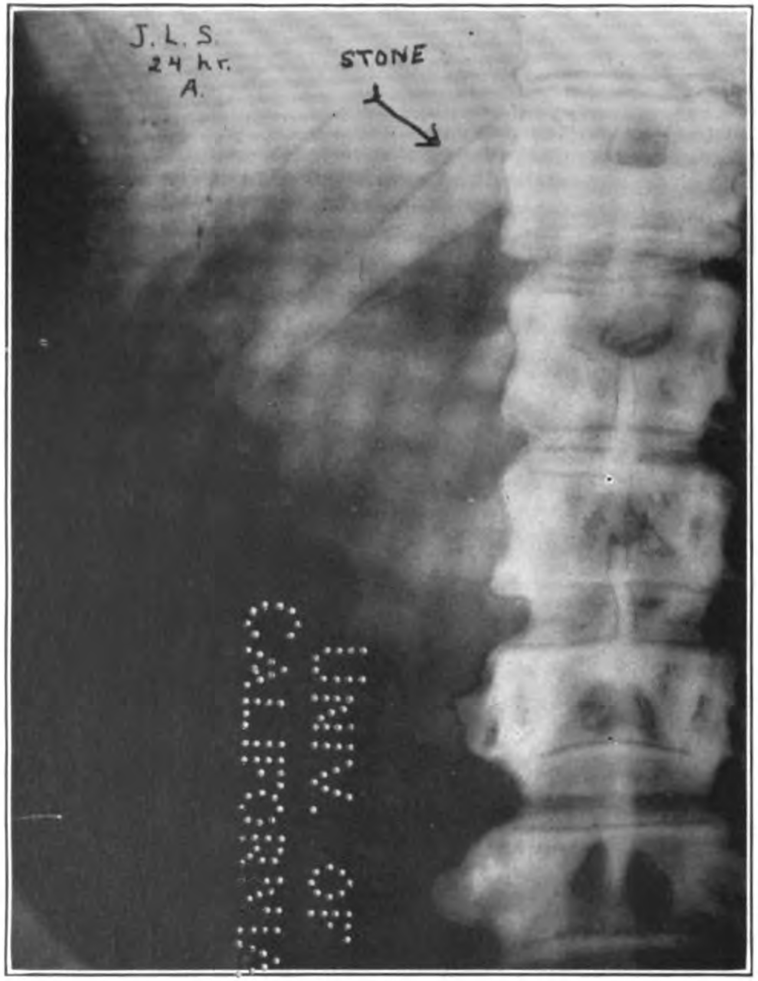
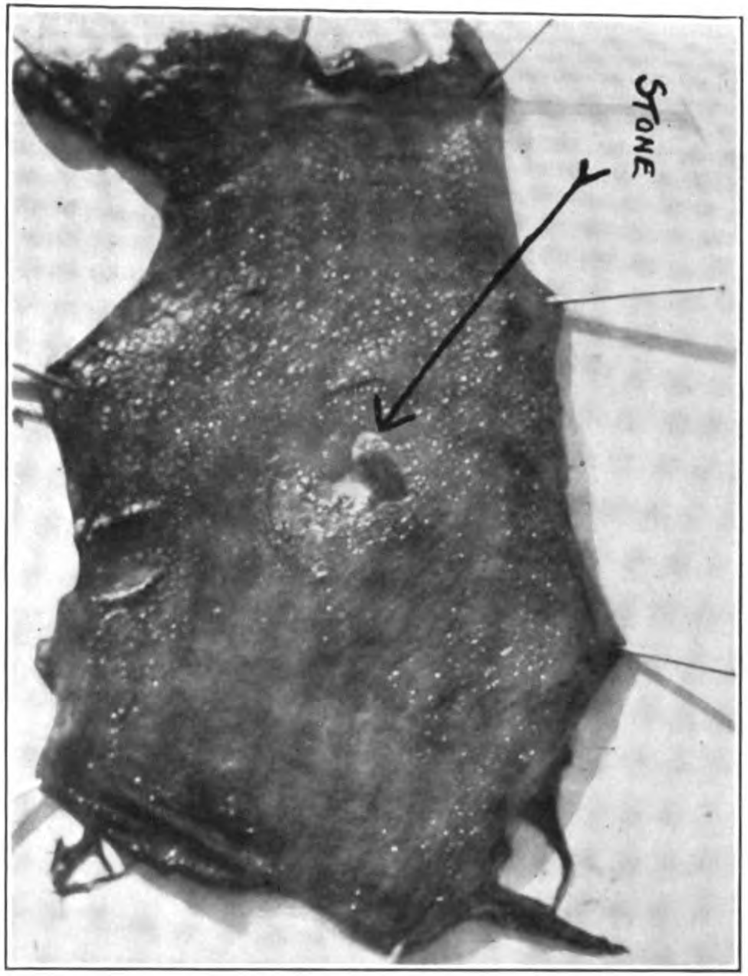
566—5



a



b

FIG. 5.—CHOLELITHIASIS. *a*, (J. L. S., VET.) GALL BLADDER NOT WELL VISUALIZED. STONE WAS VISIBLE AT FIFTH, EIGHTH, TWENTY-FOURTH, AND THIRTY-SIXTH HOURS. *b*, PHOTOGRAPH OF SPECIMEN SHOWING STRAWBERRY GALL BLADDER AND STONE

566—6

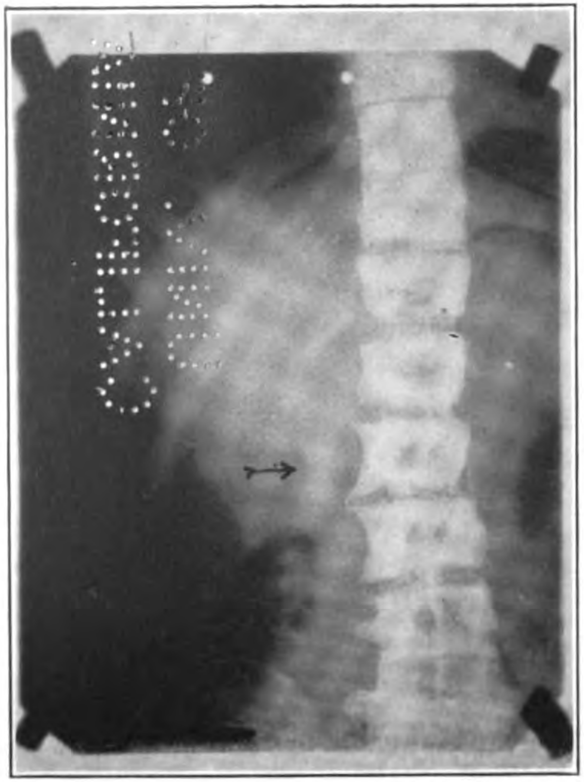


FIG. 6.—EIGHTH HOUR. SHOWING CONSTRICTIONS OF GALL BLADDER. OPERATIVE FINDINGS: CHRONIC CHOLECYSTITIS WITH ADHESIONS

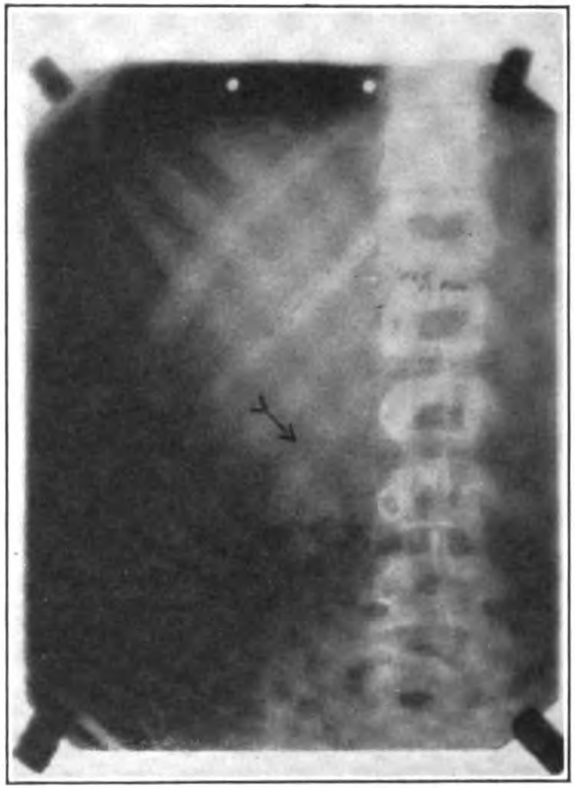


FIG. 7.—SHADOW VISIBLE AT TWENTY-FOURTH HOUR ONLY. DELAY IN FILLING, IRREGULAR OUTLINE, PALE SHADOW. OPERATIVE FINDINGS: CHRONIC CHOLECYSTITIS WITH ADHESIONS

TABLE I

Case	Cholecystographic findings	Operative findings.
J. L. S. (D-166, veteran).	Stone; no shadow of gall bladder	One stone, chronic cholecystitis. (Strawberry gall bladder, Fig. 5.)
H. L. C. (F.-3c., D-381).	Pale shadow and irregular outline (appeared at the 24th hour only).	Chronic cholecystitis and adhesions surrounding gall bladder. (Fig. 7.)
H. S. (D-348, Corp.)	Constriction of the shadow; latter was not very distinct.	Chronic cholecystitis with many adhesions around gall bladder. (Fig. 6.)
B. F. C. (veteran)	No shadow	Chronic cholecystitis.
C. T. L. (S.-2c.)	Shadow not very distinct, irregular in outline; delay in filling.	Do.

The other 15 cases reported as presenting pathological conditions were not submitted to operation. Consequently, the findings could not be proved. Abnormal conditions were indicated by various features. Some of these findings are illustrated in Table II.

TABLE II

Case	Fifth hour	Eighth hour	Twenty-fourth hour	Thirty-sixth hour	Remarks
D-81	No shadow	No shadow	Very faint shadow and irregular outline.	No shadow	Delay in filling; scanty filling; irregular and not uniform.
E-100	Faint shadow of gall bladder.	do	No shadow	do	Irregular outline; not homogenous.
D-431	Small and indistinct shadow.	Similar to fifth-hour shadow.	Shadow persists, similar density.	Shadow persists, similar density.	Irregular outline; loss of elasticity in gall bladder.
D-430	Shadow is distinct, outline regular.	Similar to previous shadow.	Similar to previous shadow.	Almost as distinct as in the fifth hour.	Loss of elasticity.
D-317	No shadow	No shadow	No shadow	No shadow	Complete obstruction in cystic duct.
D-235	Irregular shadow.	Shadow not homogenous.	Similar to previous film.	Shadow persists, but smaller.	Small area of intense density in fundus.
D-236	No shadow	No shadow	Faint shadow	Faint shadow persists.	Delay in filling and emptying.
D-235	do	Faint shadow	do	Faint shadow	Persistence of shadow is indicative of gall-bladder disease.
D-221	do	No shadow	No shadow	No shadow	Complete obstruction in duct.
D-220	do	do	do	do	Do.
D-133	do	do	do	do	Suggestive of complete obstruction in duct.
E-177	do	Gall bladder visualized.	Similar to shadow of the eighth hour film.	Shadow persisted after 48 hours.	Persistence of shadow after 48 hours is indicative of gall-bladder disease.

TABLE III

Case	Shape	Position	Contour	Uniformity	Density
D-234	Oval	Normal	Regular	Uniform	Homogeneous.
D-235	Angular	Level second lumbar vertebra.	do	Uniform except for lower half, small area of less density (gas in colon).	Do.
E-1838	Tubular	Level upper border second lumbar vertebra.	do	Uniform	Do.
E-1727	Pyriform	Level fourth lumbar vertebra.	do	do	Do.
E-1837	do	do	do	do	Do.
E-1718	Oval	Normal	do	do	Do.
E-100	do	do	do	do	Do.

TABLE III—Continued

Case	Fifth hour	Eighth hour	Twenty-fourth hour	Thirty-sixth hour	Remarks
D-234	Large, regular	Smaller and more dense.	Less distinct, larger.	Shadow disappeared thirtieth hour.	
D-235	do	do	Only fundus seen; small, dense.	Shadow disappeared thirty-third hour.	
E-1838	do	Much smaller and more dense.	Much smaller; marked density.	Disappeared 33½ hours.	Cholecystoptosis.
E-1727	No shadow	Well visualized; dense, ptotic.			
E-1837	Large, well visualized, moderate density.	Smaller; more dense.	Smaller; similar density.	Well visualized, smaller; density, same as in eighth hour.	Not visualized at forty-eighth hour. Slight delay in emptying, but within normal limits.
E-1718	Moderate density, definite shadow.	do	Smaller; less dense.	Disappeared	
E-100	do	do	do	do	

This table shows the normal response to the test. It also illustrates important differences between normal and pathological findings. Compare with Tables I and II.

TOXICITY, REACTIONS, AND CONTRAINDICATIONS

Carman states that a severe reaction is one of vasomotor shock, with an increase in blood pressure, followed within a few minutes by a sharp fall. Patient experiences sense of discomfort, headache, dizziness, pain in back, flushing of the skin, and, in more severe reactions, vomiting, incontinence, and palpitation of the heart. This method is contraindicated in the following cases: Patient suffering from cardiac or renal disease, arteriosclerosis, diabetes, and severe constitutional disease, and in neurotic patients.

Advantages of the intravenous method.—1. Results of the intravenous method are more satisfactory.

2. Intravenous method should be used to confirm the findings of the oral method in cases where the latter failed to visualize the gall bladder.

Disadvantages of the intravenous method.—1. Reactions possibly more common than with the oral method as reported by various workers. In our series the intravenous method did not show any more reactions than the oral method. This is probably due to the type of cases that came under our observation, also to the comparatively small dose.

2. Possibility of sloughing at the site of injection. We believe that if the above-described apparatus is used this disadvantage can be entirely eliminated.

Advantages of the oral method.—1. Possibly the oral method is safer.

2. More simple to administer.

3. Hospitalization is not required.

Disadvantages of the oral method.—1. Some patients vomit and lose most of the dye given by mouth.

2. Filling time can not be so accurately determined as by the intravenous method.

3. Capsules or pills containing the dye may not be digested sufficiently to liberate the dye, consequently cystograms are not obtained.

4. The gall-bladder shadow is less dense than that obtained by the intravenous method.

Whitaker, Milliken, and Vogt state:

> Patients suspected of having gall-bladder disease should first be given the drug by mouth. If a normal, clearly outlined shadow, which diminishes rapidly in size during digestion is obtained, the probability of gall-bladder disease is slight. If, on the other hand, the shadow is imperfect or absent, then an intravenous injection of the drug should be made in order to confirm the findings.

I believe this is good advice and should be followed especially by those who are not properly equipped to perform the intravenous method.

Summary and Conclusions

1. Cholecystography with the aid of sodium tetraiodophenolphthalein is a practical and apparently safe method in the diagnosis of cholecystic disease.

2. The intravenous administration of sodium tetraiodophenolphthalein in cholecystography has given more satisfactory results than the oral method, but the possibilities of the latter should not be underestimated.

3. In the presence of cirrhosis, hepatitis, or other extensive pathology of the liver, cholecystography is of little value as the dye is not excreted in sufficient quantities to visualize the gall bladder.

4. When the cystic duct is completely obstructed the gall bladder is not visualized even in the presence of normal hepatic function.

5. Absence of gall-bladder shadow, shadow of stones, sluggish filling and emptying time, definite irregularity in gall-bladder outline, and unchanged density which is not uniform are signs indicative of gall-bladder disease.

6. Liver-function tests should be made in all cases prior to operation to determine definitely the absence of cirrhosis, hepatitis, etc., as the findings are not reliable when hepatic function is impaired.

BIBLIOGRAPHY

(1) Graham, E. A., Cole, W. H., and Copher, G. H.; Cholecystography: the use of sodium tetraiodophenolphthalein, J. A. M. A., 84; 1175; April 18, 1925.

(2) Carman, R. D., and Counsellor, V. S.; Am. J. Röntgenol, and Radium Therapy, XII; 403; 1924.

(3) Menees, T. O., and Robinson, H. C.: Oral administration of sodium tetrabromphenolphthalein; preliminary report, Am. J. Röntgenol. 13; 368; 1925.

(4) Stewart, W. H.; Further experience with tetrabromphenolphthalein sodium salt in the Röntgenographic diagnosis of gall-bladder disease, Am. J. Röntgenol. and Radium Therapy, XIII; 259; 1925.

(5) Whitaker, L. R., Milliken, Gibbs, and Vogt, E. C.: The oral administration of sodium tetraiodophenolphthalein for cholecystography, Surg., Gynec. and Obst., 40; 847; 1925.

(6) Graham, E. A., and Cole, W. H.: Röntgenologic examination of the gall bladder. Preliminary report of a new method, utilizing the intravenous injection of tetrabromphenolphthalein, J. A. M. A., 82; 613; 1924.

(7) Palefski, I. O.: Visualization of the gall bladder with sodium tetrabromphenolphthalein by oral or intraduodenal administration through the duodenal tube, M. J. Rec., 121; 474; 1925.

(8) Graham, E. A., Cole, W. H., and Copher, G. H.: Visualization of the gall bladder by the sodium salt of tetrabromphenolphthalein, J. A. M. A., 82; 22; 1777.

(9) Stewart, W. H.: Administration of tetraiodophenolphthalein through duodenal tube, Am. J. Röntgenol. and Radium Therapy, 13; 378; 1925.

(10) Rosenthal, S. M.: A new method of testing liver function with phenoltetrachlorphthalein. The relation of impaired function to the amount of normal liver tissue. J. Pharmacol. and Exper. Therap., 23; 385; 1924.

(11) Graham, E. A., Cole, W. H., and Copher, G. H.: Röntgenological visualization of the gall bladder by the intravenous injection of tetrabromphenolphthalein, Ann. Surg., LXXX; 473; 1924.

(12) Graham, E. A., Cole, W. H., and Copher, G. H.: Cholecystography: An experimental and clinical study, J. A. M. A., LXXXIV; 14; 1925.

(13) Whitaker, L. R., and Milliken, G. A.: Comparison of sodium tetrabromphenolphthalein with sodium tetraiodophenolphthalein in gall bladder radiography, Surg. Gynec. and Obst., XI; 17; January, 1925.

(14) Milliken, G., and Whitaker, L. R.: The clinical use of sodium tetraiodophenolphthalein for cholecystography, Surg. Gynec. and Obst., XI; 646; 1925.

(15) Graham, E. A., Cole, W. H., Moore, S., Copher, G. H.: Cholecystography: Oral administration of sodium tetraiodophenolphthalein, J. A. M. A., 85; 953; September 26, 1925.

(16) Moore, S.: Cholecystography, after the method of Graham, Cole, and Copher, Am. J. Röntgenol. and Radium Therapy, June, 1925, 515.

(17) Ostenberg, R., and Abramson, H. A.: Production of liver necrosis by tetrachlorphenolphthalein, J. A. M. A., 84; 11; 800.

(18) Maurer, S., and Gatewood, L. C.: The phenoltetrachlorphthalein liver function test, J. A. M. A., 84; 13; 935.

(19) Rosenthal, S. M.: A new method of testing liver function with phenoltetrachlorphthalein, J. A. M. A., 79; 26; 2151.

(20) Rowntree, L. G., Hurwitz, S. H., and Bloomfield, A. L.: An experimental and clinical study of the value of phenoltetrachlorphthalein as a test for hepatic function, Bull. Johns Hopkins Hosp., 24; 327; 1913.
(21) Rosenthal, S. M.: The relation of impaired function to the amount of normal liver tissue, J. Pharmacol. and Exper. Therap., 23; 385; 1924.

CONGENITAL POLYCYSTIC KIDNEY [1]

With Report of Case

By E. B. McGregor, Lieutenant (Junior Grade), Medical Corps, United States Navy

Congenital polycystic kidney is a rare condition and one often overlooked during life, though more frequently recognized now than formerly. In a recent series of 41 cases (1) 26 were discovered during life, while, in an earlier series, 12 per cent diagnosed during life was considered very good (2).

Etiology

It is found in females twice as often as in males. While it is usually bilateral, it may occur on only one side. In 149 cases only 9 were unilateral (3). There seems to be a definite hereditary tendency. Crawford (4) reported 14 cases in 5 generations of 1 family. Osler reported five children of one mother as having the condition, and Paus quotes Bull's cases, which occurred in three generations of the same family.

Developmental Theory

The actual cause of polycystic kidney is still in dispute. MacCallum states that our knowledge of the condition is far from complete (6). Virchow originally believed that the cysts were due to obstruction by uric-acid crystals (7), but later modified this view and thought they were the result of chronic inflammatory obstruction of the tubules. Others have believed that the cysts are proliferative, as they are so often associated with hepatic or ovarian cysts, but this is hardly a logical conclusion. Reports of the condition found at birth and studies of fetal embryology have shed a great deal of light on the subject in recent years. It is now believed that the condition is the result of the failure of the glomerular and tubular portions of the kidney to unite in fetal life. This theory would best explain the frequently associated cystic condition of the liver, ovaries, etc. Other malformations often associated are hypertrophy of the heart, particularly of the left ventricle, arteriosclerosis (in 75 per cent of cases), meningocele, supernumerary digits, talipes, cleft palate, imperforate anus, absence of rectum, urethra, and external genitals (8).

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[1] From U. S. Naval Hospital, San Diego, Calif.

Age at Discovery

MacCallum reports a case in which delivery of the fetus was impossible until both cystic kidneys were torn out. Cabot has a series of 36 cases in which five were under 20 years of age, 10 between 20 and 40, and 16 over 40 (9).

Pathology

The kidney feels like a bag of grapes. It may be freely movable or may be very difficulty to deliver from its bed. It is frequently three to ten times normal size, and the fetal lobulation may persist. In shape it does not differ much from the normal. The surface is studded with cysts, varying in size from microscopic to that of a cherry, and containing either urinous, gelatinous, turbid, purulent, or bloody fluid, which is often of offensive odor, or semisolid crystalline material (10). Microscopically the cysts are seen to be lined with low cuboidal epithelium and between them the tissue may be normal or may show the changes due to chronic nephritis or to pressure atrophy.

Symptoms

Three stages are usually described. First, enlargement of the kidney, with or without other symptoms. Second, subjective symptoms, as dull aching. This may develop into a pain, paroxysmal in nature, worse on exercise, and relieved on lying down. Hematuria and pyuria are not infrequent. This stage may last for months or years. Secondary complications, as cardiac hypertrophy and general arteriosclerosis, usually accompany this stage. Sudden cerebral hemorrhage may occur before other evidences of disease are present. Other hemorrhagic symptoms, as petechia or bleeding from the nose and bowel, are not uncommon. Third, evidences of serious renal damage appear, and this stage is therefore of short duration. Headache, drowsiness, occular changes, albuminuria, wasting, edema of the extremities, ascites, and, finally, convulsions and coma may be expected. Death from anemia occurred in 59 out of 98 cases reported by Seiber (11).

Diagnosis

Physical examination may reveal a tumor over which the percussion note is dull. If this is bilateral, congenital cystic kidney should be suspected. Pyonephrosis and perinephritic abscess are unilateral, as is hypernephroma or any other tumor. One may be unable to distinguish whether the kidney or liver is at fault, and an enlarged gall bladder adds to the confusion. Cystoscopy is of no value except in determining the source of hemorrhage, pus, etc. The phenolsulphonphthalein test aids only in prognosis. Pyelog-

raphy has been very helpful. Braasch (12) states that in more than 50 per cent of cases there is a flattening and obliteration of one or more of the major calyces, or an elongation, rounding, and displacement of the pelvis. One might infer that every obscure case should be cystoscoped and have a pyelogram made, but Van Duzen (13) will not subject a suspected case to pyelography for fear of uremia or infection.

Treatment

Once the disease is discovered, treatment resolves itself into one of two choices. Either palliative measures must be undertaken, as in any case of chronic nephritis, or surgical measures must be adopted.

If unilateral, nephrectomy should be done. Dr. J. T. Binney (14) reports that Fred Lund and Rovsing have had the best results by exposing the kidney and puncturing the individual cysts, thus relieving the pressure and stopping the destructive process.

The case reported herewith was not recognized until autopsy. The first symptom that brought him to the attention of a medical officer was a cerebral hemorrhage, and he died a couple of hours after his admission to the hospital.

Case Report

F. W. D., private, United States Marine Corps, aged 22, was admitted at 7 p. m., August 7, 1925, in a comatose state. According to a friend he had complained of a severe pain in the back of the head early in the afternoon while playing pool, and had curled up in an easy chair and fallen asleep. About 6 p. m. he awakened, attempted to get to his feet, and fell unconscious.

Upon admission to the hospital his axillary temperature was 98°, pulse 72. He could not be aroused and was having intermittent tonic convulsions. Several times he vomited and the vomitus contained blood. Urine and feces were passed involuntarily; breathing was stertorous.

The right pupil was dilated and fixed; pupillary reflexes were absent. Ophthalmoscopic examination showed hemorrhage in both retinæ, more extensive in the right. There was a double ankle clonus, carpopedal spasm, and exaggeration of the patellar reflex. Examination of heart, lungs, and abdomen was negative; blood pressure was not recorded. Urine showed 4+ albumen. Spinal fluid was bloody and continued to flow without change of color. The patient died at 8.50 p. m., about two hours after admission, without change in his comatose condition.

Examination of his health record was of no assistance, as only mumps and abscess of auditory canal were recorded as previous illnesses. Diagnosis before autopsy was cerebral hemorrhage due to nephritis, probably a part of the essential hypertension complex.

Autopsy findings were as follows:

The body is that of a well-developed, adult male, approximately 67 inches in height, and 23 years of age. There was no evidence of external violence.

On removing the skull cap, free blood flowed in considerable quantity, and was of abnormal fluidity. Under the meninges there was a gross hemorrhage

into both lobes of the cerebrum, more extensive in the left. The arteries comprising the circle of Willis were thin walled, and, when held up to the light, were semitransparent. The thymus was present, 1 inch by 2 in size. The lungs and heart were not pathological.

The kidneys were very large specimens of the polycystic type, the right weighing 600 grams and the left 700 grams. Both were covered with cysts which varied in size from a pinhead to a large cherry. On sectioning, very little funtional kidney tissue was found.

No other organs showed any evidence of polycystic changes.

Autopsy diagnosis.—Cerebral hemorrhage, resulting from double polycystic nephritis.

REFERENCES

(1) Surgery, Gynecology and Obstetrics, 23; p. 697.
(2) Lejar's Cases, Key's Surgery.
(3) Seiber, in Cabot's Modern Urology, Vol. II.
(4) Texas State Medical Journal, Oct., 1914, by R. E. Van Duzen.
(5) MacCallum's Modern Urology, Vol. II.
(6) MacCallum's Pathology.
(7) Cabot's Modern Urology, Vol. II.
(8) Cabot's Modern Urology, Vol. II.
(9) MacCallum's Pathology.
(10) Cabot's Modern Urology.
(11) Keene's Surgery, vol. 4.
(12) Surgery, Gynecology, and Obstetrics, 23: p. 699.
(13) Texas State Medical Journal, Oct., 1924.
(14) Binney's Operative Surgery, vol. 7.

RABIES[1]

WITH ANIMAL EXPERIMENTATION

By J. B. LOGUE, Lieutenant, Medical Corps, United States Navy, and O. B. MORRISON, Jr., Lieutenant (Junior Grade), Medical Corps, United States Navy

L. E. S., a private in the United States Marine Corps, while on sentry duty at Green Street gate, United States Naval Hospital, Norfolk, Va., was bitten on the hand by a dog at about 7.30 a. m., October 21, 1925. A few minutes after the accident occurred the sentry made the following report to the officer of the day:

While walking his post he had noticed a dog running down the street and headed for the gate where he was on guard. In order to prevent the animal from entering the reservation the sentry put out his right hand. The dog, however, did not change his course and, apparently without attempting to dodge by, ran up to the sentry and bit him on the hand. Finding himself thus attacked by the dog, the guard grabbed the animal around the neck and choked him to death. The lacerated wounds on the man's hand were immediately cauterized and dressed with sterile dressings. The body of the dog was ordered sent to the laboratory for examination.

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[1] From U. S. Naval Hospital, Norfolk, Va.

The dog was a male animal of medium build and of unknown pedigree. There was no foam or froth about the mouth. The skull of the animal was opened and the brain revealed a slight amount of congestion, but no evidence of gross pathological lesions. A small section of the brain was then removed from the hippocampus. From this section of brain a number of impressions were made on glass slides after the manner described in most text books of clinical diagnosis. In addition, a number of smears were made and another small piece of brain taken from the same region was prepared for histopathological sections. The impressions and smears were stained with an eosin-methylene blue stain (Frothingham's modification of Giemsa's stain). Examinations of these preparations showed that the brain contained numerous Negri bodies. It might be stated in this connection that while the Negri bodies could be demonstrated in both the impressions and smears, the smear preparations gave us the best slides, because not only the cell bodies but the axones and dendrites stood out more clearly than they did in the slides prepared by the impression method. Several of the stained slides and a section of the brain tissues were sent to the United States Naval Medical School, Washington, D. C., and a positive report of rabies was returned by radio.

We are under the impression at this laboratory that the mere demonstration of Negri bodies in the brain of a dog should not be considered as pathognomonic of rabies. We therefore wished to determine if this was a true case of this dangerous and much-dreaded disease, and thus decided to inoculate several rabbits by the intradural method.

Four rabbits of about the same size were selected, two to be inoculated with brain emulsion from the dog and two to be used as controls. Using sterile instruments a small section of brain was carefully dissected from the region of the hippocampus of the dog's brain. An emulsion was then prepared under aseptic conditions and this emulsion finally filtered through sterile cotton and sterile filter paper. The four rabbits, after having been properly marked for identication, were given ether anesthesia. The hair was clipped from the top of the heads in order to expose the scalp. The field of operation was then washed with tincture of green soap and then prepared in the usual manner. The area selected for the operation was a point located in the median line and just dorsal to a horizontal line drawn through the middle of both eyes. A small incision, about an inch in length, was made at this point. The incision was made to extend through the scalp and underlying fascia, thus exposing the cranial bone. By means of a 4-millimeter trephine a small hole was drilled through the skull so as to expose the dura. Then a small hypodermic needle was inserted into the dura and

0.2 cubic centimeters of the emulsion of dog's brain thus injected into the subdural space of the two test rabbits. The two rabbits selected as controls were operated on in an identical manner with the exception that 0.2 cubic centimeters of sterile water was used in place of the brain emulsion. The scalp wounds were then pulled together and held closed by means of a small pad of sterile cotton covered with collodion. All four rabbits reacted satisfactorily after the operation and they were then placed in separate cages.

A careful examination of each rabbit was made daily after the operation, and they were kept under constant observation. The day following the operation all four rabbits were apparently normal. They developed no noticeable symptom until 16 days after inoculation. On the sixteenth day, however, one of the rabbits which had been inoculated with the brain emulsion began to develop a slight paralysis of its hind legs. On the seventeenth day the paralysis of the hind legs was not only much more marked but the animal began to show involvment of the spine and forelegs as well. When excited the rabbit would go into convulsions, characterized by paroxysms of generalized muscular tremors. The spine on such occasions would also show marked lateral contracture, causing the animal to bend into a typical horseshoe shape. The eyes were kept widely open and the rabbit was apparently mentally alert. On the eighteenth day the animal appeared very weak and exhausted and the symptoms were even more marked than they had been the day before. Finally the rabbit died on the morning of the nineteenth day after inoculation. The other rabbit which had been inoculated with the brain emulsion remained apparently normal until the eighteenth day after operation when it likewise began to show the same kind of paralytic symptoms. This second rabbit died four days after the onset of its symptoms.

The control rabbits remained perfectly normal throughout the entire time and never showed the slightest sign or symptom of paralysis.

The brains were removed from the two rabbits which had been inoculated with the emulsion of dog's brain just as soon as they died. Smears and impression slides were prepared and stained as had been done in the case of the dog's brain, and although a great number of slides were prepared, no Negri bodies could be found on examinations made of these preparations. The rabbit brains, like that of the dog, showed slight congestion of the meninges and brain, but no gross pathological lesions could be found.

In addition to the above study it was decided to carry the experiment a step further, so an emulsion was prepared from the rabbits' brains and the emulsion inoculated into the subdural space of two

more rabbits in the manner described above. One of the original control rabbits which, as stated before, was still apparently perfectly normal, and a new rabbit of approximately the same size, were selected for this second inoculation. The other control rabbit was kept under observation for a control in this second test.

The two rabbits thus inoculated with the emulsion of rabbit brains reacted satisfactorily after operation and showed no untoward symptoms until 19 days after inoculation. On the nineteenth day one of these rabbits developed a paralysis similar to that observed in the first-test rabbits, and this rabbit died three days after the onset of the paralysis. The second rabbit developed paralysis on the twenty-first day after inoculation, and it also died three days after the onset of symptoms.

The brains of these second-test rabbits were removed and examined, but no Negri bodies could be found in either brain.

Over two months have elapsed since the first rabbits were inoculated, and yet the control rabbit is living and has never shown any symptom of paralysis.

The marine was given the full course of antirabic serum without showing any untoward symptoms from this treatment, and of course did not develop any of the symptoms of rabies.

From the studies made in the case we concluded that this was a true case of rabies. We are unable to state at the present time just what significance should be attached to the discovery of Negri bodies in a dog's brain; but our studies seem to show that the disease may be experimentally transmitted to rabbits, and the rabbits after developing all of the clinical symptoms of rabies will die without having Negri bodies in their brains. For many years the finding of Negri bodies in a dog's brain has been considered pathognomonic of rabies; but we have been unable to find any statement in the literature available as to whether or not Negri bodies are supposed to exist in the brain of a rabbit suffering from the disease.

DISLOCATION OF THE HEAD OF THE FIBULA—A RARE LUXATION

By W. W. Hall, Lieutenant Commander, Medical Corps, United States Navy

Anatomy

The fibula is a long, slender bone with a knoblike head surmounted by a pointed styloid process. The head can be palpated under the skin just below the external aspect of the knee. On the upper surface of the head is the articular facet, which is roughly quadrilateral and looks upward, inward, and a little forward. The facet of the tibia

with which it articulates is small and is just under the external tuberosity, at the junction of the posterior and external surfaces. The tibiofibular articulation is a true joint inclosed by a capsular ligament. The joint cavity occasionally communicates with that of the knee by a small opening. The capsule is strengthened anteriorly and posteriorly by thickened bands, which are known as the superior tibiofibular ligaments. The joint is also reinforced by the external lateral ligament of the knee and the biceps tendon, both of which find their insertion in the head of the fibula. "The joint is very strong and so situated as not to be exposed to direct violence. Dislocation therefore is very rare." (Wilson and Cochrane) (1).

The movement in the superior tibiofibular articulation is small, being chiefly a slight degree of rotation or play in the anteroposterior direction. This motion is occasioned by change in the relation of the articular surfaces of the ankle joint in the various positions of flexion and extension of the foot. The joint has no other function.

Cotton (2) says that luxations of the fibular head are not common, but probably often pass unrecognized. As to causation he divides them into three classes, as follows:

1. Posterior luxation, usually caused by muscular traction through the biceps tendon.
2. Anterior luxation, probably from adduction and inward torsion (with the knee in extension), resulting in rupture of the external lateral ligament.
3. Upward luxation, from upward thrust on the fibula exerted at the ankle (abduction of the foot) with or without associated fracture (Potts).

Diagnosis

Of the diagnosis, Cotton says: "It is not easy. There is extreme local tenderness. The fibula head may be, but oftener is not, abnormally movable. Measurement from the fibular head to the tibial tubercle is our best evidence. The X ray may help." Speed (3) says: "An X ray may fail to show any deformity. The anterior-posterior view should be made from directly in front backward and both legs should be exposed for comparison."

Frequency

Concerning the frequency of dislocation of the fibular head, Golley (5) records a case and estimates the reported cases as about 25. His case was a forward and outward dislocation. Stimson (4) states the number of reported cases as 25. Speed (3) estimates them as somewhat more than 30.

Reduction and Treatment

Stimson (4) says: "The patient is usually unable to walk because of pain, but can move the knee freely. Reduction has usually been easy by direct pressure while the knee was partly flexed. I was obliged to resort to arthrotomy in one case. Liggett refers to an unreported case in which reduction failed after two attempts under anesthesia. In two cases which were not seen until sometime after the accident the displacement was permanent. In one the dislocation could not be reduced and the leg remained weak. The patient was able to walk but not to jump. In the other case reduction was accomplished but dislocation immediately recurred and local pressure and immoblization failed to cure." He suggests retention with adhesive plaster as a possible aid in such a case. Cotton's treatment is immobilization with flexion of the knee, especially in posterior displacement, to relax the biceps. "In recurrent dislocations an attempt to promote short fibrous or bony union at this point would seem to be indicated." Speed (3) says: "Reduction by direct pressure of the surgeon's fingers is not difficult, but the bone tends to slip out at once on account of the poor retention by torn ligaments." He recommends fixation in partial flexion for four to six weeks and the subsequent strengthening of the joint by adhesive bands. Prognosis as to function is excellent, he says, and cases which resist reduction or will not remain reduced can be held in place against the tibia by a nail inserted through a small skin opening.

Report of Case

Mrs. C., a young matron, when first seen, about 30 minutes after injury, was sitting with the left knee partially flexed and was apparently in much pain. She said that the leg was most comfortable in the flexed position and that motion (either extension or further flexion) occasioned considerable pain. Her husband had slipped and fallen on her knee as she lay on a couch and she had flexed her leg and turned her body in attempting to avoid the blow.

On palpation and comparison with the uninjured knee the head of the fibula was seen to be dislocated backward.

Reduction was easily accomplished by pressure forward with the fingers, the knee being partly flexed. A loud snapping sound was heard as the fibula slipped back into place.

A pad was placed behind the partially flexed knee and against the head of the fibula and a posterior splint applied. Later the knee was padded as before and a posterior, gutter, plaster of paris splint moulded. The splint was removed each night and passive motion and massage applied to the muscles of the leg. The splint was removed at the end of about three weeks and the knee bound with cotton elastic bandage. Recovery was complete.

Dislocation in this case was probably due more to direct violence than the pull of the biceps tendon on the head of the fibula after the rupture of the capsular ligaments and the anterior superior tibiofibular ligament.

REFERENCES

(1) Wilson & Cochrane, Fractures and Dislocations, p. 638, Lippincott, 1925.
(2) Cotton, Dislocations and Joint Fractures, p. 533, W. B. Saunders Co., 1910.
(3) Speed, Fractures and Dislocations, p. 810. Lea and Febiger, 1916.
(4) Stimson, Fractures and Dislocations, 8th ed., p. 901, Lea and Febiger.
(5) Golley, Am. Jour. Surg., XXI; 171; 1907.

TREATMENT OF MULTIPLE FRACTURES OF BONES OF THE FACE

By M. W. MANGOLD, Lieutenant Commander, Dental Corps, United States Navy

The following case report may be of particular interest to medical and dental officers in view of the excellent result obtained by means of a simple line of treatment which is applicable to the majority of cases of fractures of the maxillae. The appliance used was the modified Baker anchorage, which has been described by Darnall[1] and by other writers and used generally by naval dental surgeons.

The patient, D. R. K., an apprentice seaman, was admitted to the hospital during the night as an emergency case, following a fall from his hammock. His face was swollen and discolored; there were abrasions over the nose and chin, the left eye was nearly closed, and the man bled from the nose and mouth. Fractures of the nasal bones and the nasal septum were reduced immediately by the rhinologist, hemorrhage was controlled by packing the nares, and ice caps were applied to the face.

A radiogram disclosed, in addition to the fractures of the nasal bones, a fracture through the neck of the left condyle of the mandible an oblique fracture through the right angle of the mandible, an irregular fracture through the region of the lower right cuspid, and an adjoining fracture of the alveolar process involving the inferior right incisors. The radiogram did not show a definite line of fracture in the superior maxilla, but the entire right alveolar process was detached and movable. On account of the acute inflammation present, no attempt was made to reduce these fractures immediately. The patient was placed on liquid diet, mouth washes were prescribed, and the application of ice caps was continued.

Figure 1 shows the patient as he appeared on the fourth day following admission to the hospital. On the tenth day an arch wire

[1] Darnall, W. L.: "The use of the modified Baker anchorage in the naval dental service," U. S. Nav. Med. Bull., 19: 1, 42, July, 1923.

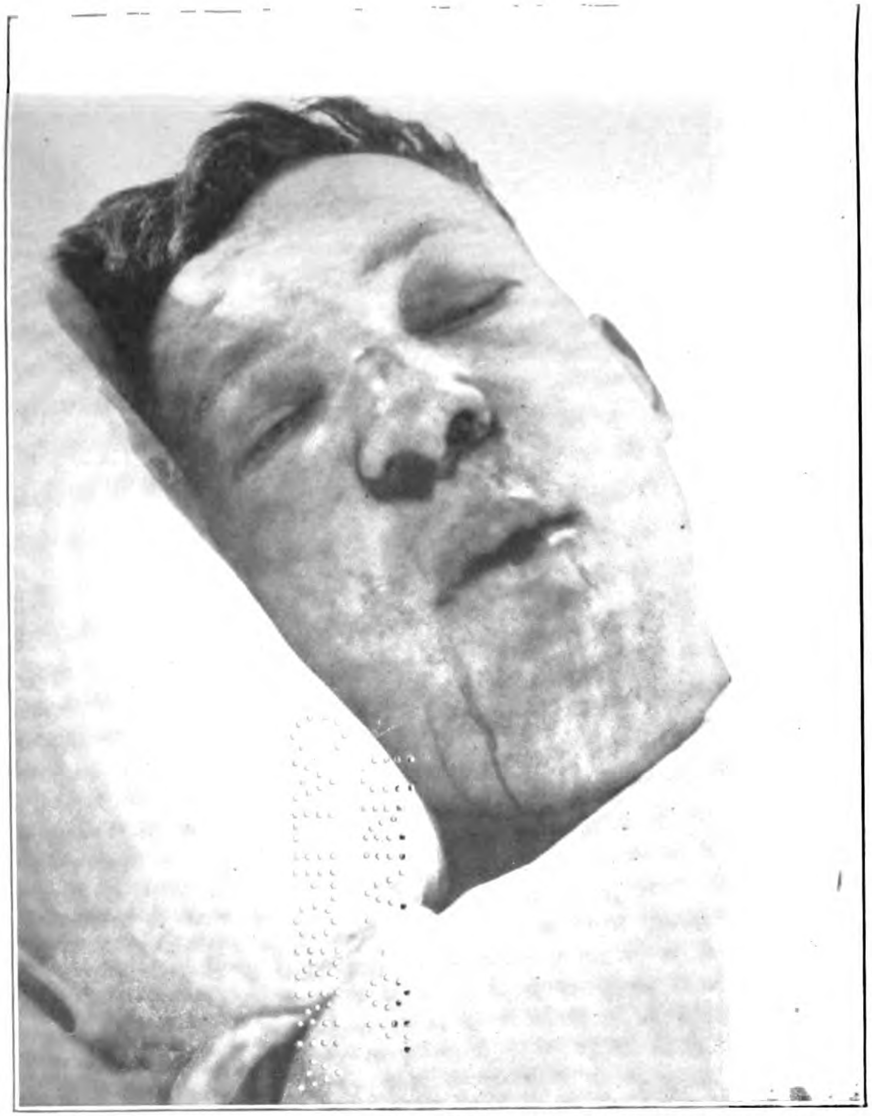

FIG. 1.—PATIENT ON FOURTH DAY AFTER ADMISSION TO THE HOSPITAL

FIG. 2.—PATIENT THE DAY FOLLOWING REMOVAL OF ALL FRACTURE APPLIANCES. PROFILE, FACIAL CONTOUR, AND OCCLUSION NORMAL

was adapted to the teeth of the upper jaw, and two days later the lower arch wire was adjusted and ligated to the teeth after the entire body of the mandible had been anesthetized. In as much as it was impossible to bring the jaws together and gain the advantage of the natural splint afforded by the occlusion of the teeth, a Barton bandage was applied and tightened twice daily until normal occlusion was obtained. Rubber intermaxillary ligatures were then applied to connect the arch wire lugs.

The arch wires and ligatures were cleaned thoroughly twice daily, in conjunction with irrigations of the mouth, for six weeks. The ligature bands then were removed and it was found that all of the fractures had united except the one in the region of the inferior right cuspid. A radiogram showed the cuspid to be directly in the line of fracture, so the tooth was removed and the intermaxillary ligatures were replaced for a period of fourteen days. At the end of this period, the fracture appeared to be well united and the entire appliance was removed. Figure 2 shows the patient as he appeared at this time. His profile, facial contour, and occlusion were normal.

The patient was instructed daily in exercising the jaw and, as he was unable to open his mouth more than one-half inch, treatment with the oral wood screw was given twice daily. Massage treatments and the application of heat also were continued for a period of 10 days at the end of which the patient was found to have regained normal control of the jaw.

ANEMIA, SPLENIC (BANTI'S DISEASE)

By A. J. Toulon, Lieutenant Commander, Medical Corps, United States Navy

Recognizing the fact that Banti's disease is a rather rare condition, it is with considerable reservation that such a diagnosis has been made in this case, but, after an observation of about three weeks, eliminating such other conditions as might give rise to some of the clinical symptoms present, nothing seems to remain but to make such a diagnosis.

Case Report

The patient, E. P., seaman, first class, has been attached to U. S. S. *O-10* for about seven months, and for three months prior to his admission to this dispensary had been at Balboa, where his ship was undergoing overhaul. He was born in Irving County, Ga., October, 1900; had had seven years' schooling; was a farmer by occupation prior to enlistment; and enlisted in the Navy November 21, 1923.

Family history.—Father, two brothers, and three sisters living and apparently well. Mother died at age of about 40 years, after a protracted illness;

cause of death unknown to patient. He states that so far as he knows there is no history of cancer, tuberculosis, or insanity in his immediate family or relatives.

Personal history.—Measles and several attacks of fever of unknown origin (probably malaria) as a child. Treated in 1923 for uncinariasis with carbon tetrachloride. Denies venereal infection. Does not use alcohol.

Present illness.—About one year ago noticed abdomen was becoming enlarged, but states that after active catharsis this condition would disappear. No other symptoms were apparent to the patient. About 10 days prior to admission his abdomen became very much enlarged and he experienced difficulty in breathing.

Physical examination.—A fairly large, well-muscled man; slightly jaundiced; abdomen enlarged; no outward signs of edema; temperature 98° F., pulse 69, respiration 20. Heart and lungs negative; ear, nose, and throat negative; skin around lower abdomen and pubes showed evidence of scabies. No evidence or history of venereal disease. Palpation and percussion of abdomen revealed a large mass extending from the region of the spleen toward the umbilicus, and liver dullness about 3 inches below costal margin. Dullness in the flanks and tympanites on right side and upper abdomen. Signs indicative of considerable free fluid in abdomen. Paracentesis performed and 5,500 cubic centimeters of clear ascitic fluid removed. Reexamination of abdomen after paracentesis showed enlarged spleen extending 3 inches below left costal margin and liver dullness about three fingers' breadth below right costal margin. No evidence of varicosities about umbilicus, nor of general adenopathy.

Urinalysis.—Reaction, acid; albumen, negative; sugar, negative. Microscopic: Few cells and many urates.

Examination of stools.—Negative for ova; considerable free blood present.

Examination of blood.—R. B. C., 3,800,000; W. B. C., 4,000; Polys., 49 per cent; L. Lymph., 20 per cent; S. Lymph., 25 per cent: T & M. 5 per cent; Eosin., 1 per cent; Baso., 0 per cent; Hemoglobin, 65 per cent. Wassermann., negative; Vanden Bergh, positive for bile on direct reaction. Blood pressure: Systolic, 140; diastolic 70. Examination of ascitic fluid, negative. Kahn precipitation test, negative.

Repeated blood examinations have given a constant low color index and a leucopenia between 3,800 and 4,000.

Other than respiratory distress, due to the accumulation of ascitic fluid, and a mild jaundice, there are no subjective symptoms determinable. Patient eats and sleeps well, is fairly strong, and is up and about.

The main points considered in arriving at a diagnosis of splenic anemia are as follows:

(*a*) Chronicity of present illness (probably dating back for several years).
(*b*) Enlarged spleen.
(*c*) Enlarged liver.
(*d*) Slight jaundice.
(*e*) Hemorrhage in bowels.
(*f*) Ascites.
(*g*) Persistent leucopenia with low color index.
(*h*) No adenopathies.
(*i*) Lack of constitutional symptoms.

The treatment instituted in this case consisted of active catharsis and increasing doses of Fowler's solution. Splenectomy has been considered, but with the associated ascites is considered hazardous.

This case is reported after a preliminary study with limited facilities for laboratory aids in diagnosis. A board of medical survey has recommended transfer to a naval hospital in the United States. Possibly after further study other symptoms may develop, and better diagnostic facilities may reveal conditions that necessitate a change of diagnosis; nevertheless the case presents many features that may prove interesting to many.

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NOTES AND COMMENTS

TREATMENT OF PEPTIC ULCER BY PHYSIOLOGIC REST

Progress in preventive medicine, in methods of diagnosis, and in the treatment of certain diseases has been almost unbelievably rapid in recent years. The surgical treatment of gastric and duodenal ulcers has reached a high state of perfection and is now fairly well standardized in the best clinics. Improvements in the nonsurgical treatment of these ulcers has, however, not kept pace with the advance made in the surgical treatment and many are all too prone to consider that everything possible for the patient is being done if he is given large doses of sodium bicarbonate and a few simple directions as to diet. That this is not true, and that the point of attack should be not only the ulcer but the patient himself, is well brought out by Dr. Frank Smithies, professor of medicine in the University of Illinois, in a paper entitled " A consideration of factors concerned in the production and the healing of peptic ulcer, with a report of the results of treatment of 470 patients by the 'physiologic rest' régime," published in Annals of Clinical Medicine for December, 1925.

In this paper Smithies gives his reasons for adopting the " physiologic rest method of treatment in preference to all others and shows very conclusively that, in his hands at least, the results obtained are sufficiently good to justify its continued use by him and to encourage others to adopt the same method.

In his introduction, the author states that the regimen which he has planned and instituted has been used by him in the treatment of 470 selected cases of peptic ulcer. In 128 of these the ulcers were wholly gastric; in 36, pyloro duodenal; and in 306 cases, duodenal. The patients were observed between 1914 and 1924, but the present study does not include those treated between 1922 and 1924 because the writer considers two years as insufficient time in which to establish indisputable proof of results. Nor are 302 patients who were regarded as subjects for surgical care included.

Smithies writes that—

A special ulcer regimen was gradually evolved in my clinic, partly because the accumulating new facts in the field of digestive ailments demanded a readjustment of our ideas with respect to both diagnosis and treatment, but, mainly, on account of the steady stream of ulcer "recurrences" (our own cases and

those of others) which appeared following more or less lengthy seances of management instituted on the old lines suggested years since by Leube, Lenhartz, Stewart, Fenwick, Ewald, or by recent regimens, of essentially like type, revamped under numerous names. Unbiased analysis of the failures ("recurrences," "complications," etc.) compelled the admission that so-called "standard" methods of peptic-ulcer treatment (particularly the nonsurgical) implied a narrow, ancient, and unscientific conception of ulcer etiology, incidence, pathology, life history, clinical syndrome or possible complications, and that therapeutic management, medicinally and dietetically, was unjustifiedly empiric, giving little or no consideration to well-established facts connected with the interference of gastric physiology, chemistry, and digestive function brought about by ulcer occurrence.

Attention is called to the fact that although physicians are agreed that peptic ulcer is a local affection which results from extremely varied systemic disturbances, treatment has consisted entirely of attempts to heal the local lesion, and has been the same in all cases.

Data relative to cure of ulcer by "standard" methods of treatment are, according to Smithies, "especially bewildering and unconvincing" because of the liability to error in diagnosis and because, in many cases, "relief of subjective symptoms is recorded as ulcer cure." Various writers are quoted to show the difficulty of knowing that an ulcer is healed. Lemon summarized the experience of the Mayo clinic with the "Sippy regimen" by stating that "since the surgical examination of these cases has proved that they heal spontaneously only in rare instances, the disadvantages in such routine treatment (Sippy regimen) are manifest. After a period of serious symptoms, lasting for some weeks, the patient with duodenal ulcer may have complete relief and, yet, if operated on during the quiescent period, the ulcer will almost regularly be found open and unhealed. At operations performed in many cases within only a few weeks of the completion of a rigid, medical management, and at operations performed during the remission of symtoms, an active ulcer was found. The remission in the latter case represents the normal resting stage; in the former, it is artificially produced. The supposed cures of chronic ulcers of the stomach and duodenum (by nonsurgical procedures) may be compared with the supposed cures following each attack of recurring appendicitis or gallstone disease."

Figures representing the percentage of cures resulting from various methods of nonsurgical treatment of peptic ulcers have been given from time to time, but these are not considered by Smithies as being based upon sufficiently accurate information to render them of great value.

Percentages of cure by surgical procedures are very encouraging, but Smithies, in a study of 273 cases following gastro-enterostomy,

found only 20.9 per cent "complaint free," 49.8 per cent were "clinically comfortable," and 38 per cent were "improved." In all, "88 per cent were benefited subjectively by operation, and of this number approximately 70 per cent received permanent benefit."

Smithies considers that the management of these cases leaves much to be desired, and that the "time has now arrived for an attempt toward investigating what may be termed 'pre-ulcer pathology.'"

Prevention of ulcer is the ideal for which the author is striving. To reach this ideal "* * * every ulcer, definitely known to exist to-day, should be carefully and exhaustively studied, not only from the standpoint of its clinical manifestations, its pathology and its interference with gastric function, but also with regard to the previous ailments or conditions in the individual which have contributed to a constitutional or a local visceral status permitting ulcer eventually to develop. This field is a fruitful one; a few decades hence, probably, it will be considered an indication of poor medical practice if, in a community, great numbers of peptic ulcers exist. Much of the ulcer cure is intimately concerned with the subject of ulcer etiology."

The common conception of peptic ulcer, even to-day, is that of "acid corrosion." This has led to all treatment being directed toward overcoming acidity and a neglect of the search for the *primary* cause. Smithies says: "* * * It is sufficient to state that fully *97 per cent of all peptic ulcers arise not primarily in the viscera*, but they represent *secondary visceral lesions produced as a consequence of a pre-ulcerous systemic disturbance*." The reasons given for this fact are that "the ulcer-bearing areas in the stomach and in the duodenum are, anatomically, particularly susceptible to systemic disturbances on account of the inherent peculiarities of their arterial blood supply. * * * In the ulcer-bearing areas of the stomach and duodenum, the arteries of the submucosa relatively are sparsely distributed; they are tortuous, anastamose infrequently and are subject to powerful and repeated constrictions by numerous, interlacing, intricate, frequently-contracting muscle-bundles. * * * Added to this anatomic evidence that the ulcer-bearing areas are poorly equipped from the circulatory side, we have the valuable contributions of C. G. Heyd. He has demonstrated a close, lymphatic interrelationship existing between the appendix, cecum, bilary tract, the pylorus and the antrum. * * * When these studies are appreciated, it will be readily understood how it is possible for ulcer-producing agents, arising far from the ulcer-bearing areas, to cause and maintain those peculiar, local, visceral conditions the end result of which is peptic ulcer."

Smithies divides the mechanism leading to ulcer formation into two main types:

1. Interference with the blood supply to the pyloric third of the stomach and the first fourth of the duodenum, due to (a) bacterial emboli, (b) arteriole and capillary endarteritis or sclerosis, (c) arteriole and capillary spasms, (d) vascular stricture, and (e) arterial or venous rupture. These may be brought about in various ways, but the end result is the same—an upset in the chemical balance which has prevented the proteolytic action of free hydrochloric acid and pepsin. "* * * It matters not whether hydrochloric acid is of high or of low concentration; so long as the triad, devitalized protein, HCl and pepsin is present, proteolysis occurs. The ulcer size, its form, penetration and the resultant complications (as hemorrhage and perforation) directly depend upon the depth, from the mucosa into the stomach wall, at which complete vascular blocking ceases. In a general way, the visceral damage is self-limited in extent and can not be prophesied."

2. Infection carried by the lymph-stream draining from the appendix area and biliary tract probably results in many ulcers becoming secondarily infected.

In discussing the physiology of the stomach, the author shows that in ulcer cases it is not necessary for the gastric chemistry to be altered, that the ulcer is not caused by an increased acidiy, and that the ulcer does not bring about an alteration of acidity. Study has shown that the range of strength of normal gastric acid carries it well beyond the strength found in gastric ulcer, and that the pain of gastric ulcer is not due to irritation of inflamed mucous surfaces by gastric juice rich in hydrochloric acid and pepsin. Various observers have shown that pain is not commonly present when gastric acidity is highest. " * * * The relief from pain in gastric ulcer cases is quite as prompt when alkalies are administered in low acid cases, as when such are used in high acid cases. Prompt relief of pain is also secured by the exhibition of nonalkaline agents, e. g., lavage, antispasmodics, alcohol, opiates, diet, etc. It would seem, therefore, that treatment of peptic ulcer based upon the theory of abnormal gastric chemism alone rests upon no scientific foundation but is empirical."

The mechanical factors concerned with digestion are, according to Smithies, "of greater importance than are variations in the acid and pepsin secretory function." Food delay in the antrum, where 60 per cent of gastric ulcers are found, "* * * permits of increased local movements of the viscus, greater opportunity for food and acid to remain in intimate contact with injured gastric lining; hence,

opportunity for the maximum of trauma, of infection, of digestion of damaged tissue, of stress upon the pyloric sphincter and for local alterations in circulatory and neuromuscular mechanism."

Smithies considers that these facts "furnish a logical groundwork upon which to plan the treatment of peptic ulcer," and is convinced, after more than 10 years' observation, "of the practicability and worth of the clinical application of physiologically proved principles. * * *"

The treatment adopted by the writer is based upon the facts already stated and is entirely rational. First of all, he searches for the primary etiological fault. Having found this, he attempts to eradicate or alleviate it. This he does by treating the patient as well as the ulcer, and finds that—provided complications such as stenosis, deformity, or malignancy do not exist, and accidents, such as hemorrhage or perforation do not occur—natural, orderly healing will take place.

Finding the primary cause is not always easy, and Smithies mentions many parts of the body in which it must be sought. "Inasmuch as primary foci of infection may exist in oral adenoid tissue, head sinuses, about teeth or in systemic lymph-gland chains, these must be energetically attacked. Intra-abdominal infectious strongholds likewise must be eradicated, *e. g.*, diseased appendix, gall bladder, Fallopian tubes, ovaries, ulcers or subinfections of the bowel." The removal of these foci is of great importance. Doing away with the supply of bacteria allows healing. The patient must be examined for "cardiac leakages, myocardial insufficiency, capillary sclerosis, anemia, evidences of occupational poisoning, endocrine dysfunction, improper environment, overwork, or nervous stress." Any of these may lead to or aggravate ulcers. At least two Wassermann tests should be made.

In certain cases, nonsurgical treatment will not result in cure for, as Smithies says, "After local foci of infection have been removed, and constitutional or environmental corrections arranged, the choice of treatment is further influenced by the type and position of the ulcer. Unless ulcers which are complicated by much scarring or which produce great gastric or duodenal deformity are demonstrated to be luetic, little hope of permanent relief by medical regimens can be offered. Surgery promises the greatest prospect of relief to such cases. So-called 'obstructive' ulcers which are claimed to be cured by nonsurgical treatment are not true scar obstructions but only powerful local gastric spasms. Scar tissue is an end pathologic process; if non-leutic, it yields to no known drugs. Intense pain, frequent hemorrhage, perforation or the danger of maligant change

taking place in calloused gastric ulcers likewise contra-indicate non-operative care. Unfortunately, we have no clinical or laboratory tests which indicate to us what type of gastric ulcers will become malignant or when early malignant change is taking place. However, we can be consoled by knowing that malignancy in connection with duodenal ulcer is rare. The Röntgen demonstration of calloused gastric ulcer exceeding 2 cm. diameter, when such is associated with history of frequently recurring ulcer symptoms, and the positive chemical test for blood *constantly* determined in the stools, form a clinical hint for malignancy which can not be disregarded. The most competent clincians are agreed that calloused, recurring ulcers located in the pyloric end of the stomach should be treated operatively. Excision of all gastric callouses should be performed, when mechanically possible, wherever they may be located. If excision is impractical, then infolding or cautery puncture, with or without gastrojejunostomy, yields the most satisfactory results. In nonobstructing ulcers, it would seem that gastrojejunostomy should always be accompanied by permanent pyloric closure if one is to secure a perfect and permanently emptying stoma. I see no logical reason for the shock-producing, extensive gastric resections advocated by Finsterer."

In other words, careful selection must be made of cases which are to receive nonsurgical treatment, if success is to be expected.

The four principles underlying treatment of peptic ulcers are given as follows:

1. The recognition that such ulcer is not a primary gastric or duodenal ailment.
2. Recognition of the type of ulcer.
3. Gastric chemistry plays a comparatively insignificant rôle.
4. Give the injured part physiological rest and do not interfere with natural healing.

This is simply adopting the principle used in all surgical work and applying it to nonsurgical treatment.

The administration of excessive amounts of alkalies is often followed by toxic symptoms and there is no proof that it results in a permanent reduction of gastric acidity.

The medicines used by Smithies are not administered with any idea that they promote healing of the ulcer, but are given to relieve discomfort due to (1) painful gastrospasms, (2) accumulation of overacid gastric contents associated with peristaltic unrest, or (3) pain associated with perforation or ulcer progression.

Painful gastrospasms are controlled by diet; in some cases, atropine, tincture of belladonna, or bromides are used. Occasionally, orthoform, in 10-grain doses, is given.

For the relief of overacid gastric secretions, sodium bicarbonate is contraindicated because such large quantities are necessary that excessive gastric secretion is brought about and toxic symptoms are liable to follow. If alkalies are used, frequent small doses of milk of magnesia or solutions of calcined magnesia are preferred. Smithies rarely uses alkalies and only occasionally does he employ gastric lavage.

The pains of perforation or ulcer extensions are controlled by keeping the stomach empty, by giving morphine, by rest in bed, and by hot compresses to the abdomen.

Hemorrhage is, of course, an indication for early operative intervention.

The advantages claimed by Smithies for his method of treatment are many and his results have been excellent. As he says, his results are probably better than would be those of some one less experienced in the use of this method. The treatment is not difficult, however, and should be given a thorough trial.

Smithies found that, in his hospital cases, the average stay in hospital was only 26 days and the stay in bed, less than 9 days.

All pain had disappeared in 40 per cent of patients within 24 hours; an additional 33 per cent were relieved in 48 hours; 8 per cent required 72 hours; 15 per cent, almost 96 hours. In only 4 per cent was it necessary to use opiates.

The subjective distress—ordinarily attributed to excessive gastric secretion, but which Smithies considers as being due to excessive motility—is relieved by the physiologic rest which produces visceral relaxation.

Of 41 per cent of Smithies' cases which showed occult blood, 92 per cent were blood free at the end of five days.

Seven of the 470 cases of the series went on to perforation. These were poor surgical risks upon entrance to the hospital, otherwise they would have been given the benefit of early surgical intervention.

As proof of healing, Smithies states that 66 of the ulcer patients came to laparotomy for numerous intra-abdominal lesions, after treatment was completed, and that in 54 of these (82 per cent) completely healed scars were found. Röntgen proof of healing was shown in 94 cases.

In the patients who had recurrence of symptoms, the time interval between attacks was, in one group, increased to an average of 30 months from a previous average of five months. Other groups showed intervals of 37 and 44 months.

For the whole series of 470 cases, recurrence was noted in 14 per cent (66 cases), while claim of cessation of the ulcer process seems justified in 77 per cent (361 cases).

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These results compare very favorably with the results of surgical treatment and are superior to those of other forms of nonsurgical treatment. Should this method be generally adopted, it seems probable that many sufferers from peptic ulcer would be spared the ordeal of a major surgical operation and have a better chance for permanent relief than they now have with the methods in more general use.

DENGUE

The entire issue of the Philippine Journal of Science (29: 1 and 2, 1926) is given up to the report by Lieut. Col. J. F. Siler, Maj. Milton W. Hall, and Maj. A. Parker Hitchens, all of the Medical Corps, United States Army, on their important and painstaking experimental work done at the Bureau of Science and at Sternberg General Hospital, Manila, on "Dengue, its history, epidemiology, mechanism of transmission, etiology, clinical manifestations, immunity, and prevention."

The work upon which this report is based was begun in the early part of 1924 and has not yet been completed, but it has been carried far enough to warrant certain definite conclusions which have, seemingly, been proved beyond the possibility of doubt.

The objects of the investigators were two: (1) To find the specific organism of dengue, and (2) to confirm or refute the claim that dengue is transmitted by *Culex* mosquitoes. The first has not been accomplished, while the second has, *Culex* having been eliminated as a carrier of dengue.

Of the three principals in the investigations, Lieutenant Colonel Siler had general charge of the work and directed the investigation into the relationship between mosquitoes and the disease; Major Hall had charge of the investigations into etiology; Major Hitchens was in charge of the work on immunity.

In the report a very full account of the work done is given, and all naval medical officers will profit by reading it in full. For the present, however, it is sufficient that we quote the summary, as this shows the scope of the work and contain much of practical value for those whose duties require them to spend much time in localities where dengue is endemic. The summary follows:

1. Dengue and yellow fever are transmitted by the same species of mosquito (*Aëdes ægypti*), and the mechanism of transmission for both diseases is strikingly similar. Epidemics of both dengue and yellow fever are therefore subject to the same control measures.

2. The control of epidemics of dengue usually is accomplished by a material reduction in the mosquito population of the community.

3. The mechanism of transmission briefly is as follows: The dengue patient infects mosquitoes during the first three days of illness; the infected mosquito is able to transmit the virus eleven days after its infection; infected mosquitoes remain infective throughout life; hereditary transmission of the virus does not occur.

4. Epidemics of dengue can occur only when there are simultaneously present cases of dengue fever, large numbers of *Aëdes ægypti*, and large numbers of nonimmune individuals.

5. *Aëdes ægypti* control campaigns must be based upon a consideration of its life habits; it is one of the most highly domesticated of mosquitoes; it apparently does not hibernate; it disappears when the atmospheric temperature falls appreciably below 59° F. (15° C.) and remains there for any great length of time; it prefers to take blood from man; it is essentially a "day" biter, but may take blood at night; its average length of life, under natural conditions, is probably not more than six weeks; it breeds by preference inside human habitations and on the premises thereof; it practically always deposits its eggs in collections of clear water; its eggs, being very resistant to an unfavorable environment, retain their vitality after storage in a dry place for several months; the eggs hatch normally in three days and the adult (free-flying stage) emerges ordinarily from 8 to 15 days later.

6. Dengue-preventive measures are based on two lines of attack, namely, cooperative effort on the part of individuals, both sick and well and organized mosquito-control campaigns on the part of the public-health authorities.

7. Cooperative effort on the part of individuals should include the following factors: Patients should protect themselves from the bites of *Aëdes ægypti* mosquitoes during the first three days of their illness; mosquito nets should be used at night and during afternoon siestas; nonimmune persons should avoid homes in which secondary cases of dengue occur; householders should destroy adult mosquitoes observed within the house; water should not be permitted to stand in uncovered receptacles in the house or on the premises for a longer period than seven days.

8. Consideration should be given to a number of factors preparatory to the formulation of the plan of campaign. If dengue has been endemic for a long period, many of the natives will have acquired more or less immunity, and epidemics usually are confined to the newly arrived nonimmune foreigner from areas where dengue is not endemic. If the rate of flow of the nonimmune population is small, extensive outbreaks are not likely to occur, and vice versa. In areas of endemicity maps should be prepared showing the following data: Residential sections of the major part of the foreign nonimmune element of population; the parts of the city in which a permanent type of construction for buildings predominates, as distinguished from construction of a temporary character. Charts showing daily rainfall, humidity, and temperature should be plotted. During certain seasons of the year the rainfall will be so low and may evaporate so rapidly that it would be impossible for the *Aëdes ægypti* mosquitoes to breed out in casual rain-water containers. During such seasons and under such conditions, inspections for breeding places should be concentrated on the other natural breeding places of *Aëdes ægypti*. Temperature conditions influence the seasonal distribution of dengue, and in localities in which the temperature falls below 50° F. (10° C.) and remains there for a considerable period of time, epidemics of dengue will necessarily end with the advent of cold weather.

9. In carrying out antimosquito campaigns the principal line of attack should be eradication of the breeding places (antilarval measures), but this should be supplemented by cooperative efforts on the part of the individual. The active interest and support of a moderate proportion of the population can be secured if adequate publicity of an educational nature is carried out. The area to be covered should be divided into districts and adequate and competently trained personnel assigned to each district as inspectors. Inspections should be made at intervals of not more than seven days, and weekly reports relating to breeding places detected should be submitted and consolidated in order that the effectiveness of the work may be evaluated.

OROYA FEVER

In Science (LXIII: 1625, 1926), Drs. Hideyo Noguchi and Telemaco S. Battistini, of the Rockefeller Institute for Medical Research, make "A preliminary report on the cultivation of the microbe of Oroya fever."

Although this organism was found by Barton in 1905, its cultivation had never been accomplished until now, when Noguchi and Battistini have succeeded in growing it by methods which have been developed for the cultivation of spirochetes, flagellates, and rickettsia-like organisms.

Barton described the organism, and its specificity has been established by Strong and others who "concluded that these bodies are of protozoan nature and proposed for them the name of *Bartonella bacilliformis*.

"*Bartonella bacilliformis* is a motile organism but this characteristic is lost as the cultures grow older. In form it is minute and pleomorphic, ranging from round, oval and lanceolate to rod shapes. There is a marked tendency for the individuals to clump together in masses of hundreds and perhaps thousands. The organism is Gram negative and stains reddish violet with Giemsa's solution. It varies in width from less than 0.2 to 0.5 μ and in length from 0.3 to 2.5 μ.

"Inoculation of cultures of *Bartonella bacilliformis* into young rhesus monkeys induced intermittent fever lasting many weeks. Typical endoglobular forms of *Bartonella bacilliformis* have been demonstrated in the red blood corpuscles of these animals. Intradermic inoculation of the culture into the eyebrows gave rise to highly vascular nodules, resembling the nodules of experimental verruga induced in monkeys by previous investigators. *Bartonella bacilliformis* can readily be recovered in pure culture from the blood, lymph glands, spleen and nodules, and passages from animal to animal are easily carried on."

In the summer of 1925 one of the authors (B.) went to Peru and secured blood from a case of Oroya fever. This was withdrawn into

citrate solution and carried to the Rockefeller Institute, where the cultural work was carried out.

Of the various media employed, only the aerobic media containing blood or serum yielded growth of *Bartonella bacilliformis.* "The initial cultures were obtained both on leptospira medium and on blood agar slants (20 to 30 per cent of defibrinated horse blood) containing certain carbohydrates." Pure cultures have been repeatedly obtained from the original citrated blood. "Growth occurred at 37° C. and also at 28° C. within 48 to 72 hours. Subcultures were readily obtained on similar media, and the strain has been maintained in the laboratory since the beginning of October, 1925."

DIATHERMY IN ABDOMINAL OPERATIONS

The rôle played by the loss of body heat in bringing about the disastrous results that too often follow severe surgical operations, is discussed in Surgery, Gynecology, and Obstetrics for February, 1926, by G. W. Crile under the title "The use of diathermy and of the quartz lamp for conserving the temperature of the viscera and promoting the welfare of the patient before and after abdominal operations."

As Crile says, it has long been known that chilling the intestines is harmful, while warming them is beneficial, and that death may follow exposure of the abdominal viscera. Heat, in the treatment of shock, has been long and successfully used.

Crile refers to the work of Zondek, Taylor, and others who have demonstrated that the application of cold to the abdomen is more effective in lowering the body temperature than is the application of heat in raising it. In fact, "Stengel and Hopkins found that the application of ice-bags over the gastric area produced an average drop of from 0.9 to 1 degree centigrade in 45 minutes, while the effect of hot-water bottles in the same position for the same period was almost negligible."

"These apparently anomalous observations indicate that the function of some vital organ or tissue has been depressed by the lowering of temperature caused by the application of cold, this fact explaining why the application of extensive hot packs is insufficient in some cases to overcome the result of the exposure of the viscera in the course of an obdominal operation."

Experimental research has shown that the liver is the organ involved and that it performs "* * * a function which is at least as essential to life as are the functions of the brain, heart, or the blood. It follows that to the extent to which the liver of a patient

is functionally impaired, to that extent is he unable to sustain an operation upon any part of the body, and the surgical risk is increased if the surgical attack of itself further lessens the activity of the liver. In planning the management of surgical operations, therefore, it becomes of prime importance to know how the function of the liver can best be protected. This pertains to any surgical operation, but it is of particular importance in abdominal operations, and of prime importance in operations upon the liver and gall bladder and upon the common duct in particular."

Methods by which the liver function may be protected against the effects of chilling have been found through research, and it has been shown that when the liver temperature is reduced one degree its chemical activity is reduced 10 per cent. It follows that if disease has reduced the chemical activity of the liver to 10 per cent of its normal and opening the abdomen reduces its temperature one degree, death will ensue. This happens not infrequently in operations for extensive carcinoma of the stomach or other organs.

Experiments by Crile showed that when the abdomen was opened, even if the liver was not directly exposed, its temperature fell from 1½ to 3 degrees or more and that as a result the temperature of the brain also fell from 1 to 3 degrees. Hemorrhage, with lowered blood pressure, also caused a reduction in the temperature of the liver and brain. It is easy to see that exposure of the intestines, plus a general anesthetic and operative procedures, may cause death in a patient who is not desperately ill, and that avoidance of the loss of heat may mean the difference between life and death.

In the course of his research Crile found that the introduction of heat into the abdominal cavity not only caused an increase in the liver temperature, but also raised the temperature of the brain, and that the change in brain temperature occurred one minute or more before any change was noted in the temperature of the liver.

"It would appear, therefore, that the application of heat to the liver by conserving the function of that organ should counteract the effect of the exposure of the viscera in an abdominal operation upon any patient, and in particular in operations on the liver or on the bile ducts."

Hot-water pads, hot tapes, hot-water mattresses, and a superheated operating room have failed to meet the requirements in these cases.

Crile has adopted the use of diathermy for this purpose and has found it eminently satisfactory. One pole of the diathermy apparatus is placed upon the lower chest of one side and the other opposite the dome of the liver. The current is applied continuously during the operation and the temperature of the liver and other viscera

is kept at or above normal regardless of the amount of exposure which is necessary. Because of the network of capillaries, veins, and arteries near the surface of the viscera, the blood is very quickly warmed by this method.

The apparatus is so arranged that it in no way interferes with the operation.

Crile thinks the high incidence of pneumonia following abdominal operations may be due to the cooling of the blood in the important organs combined with the general depressed function of the body as a whole, brought about by the cooling of the liver. If this be the case, prevention of loss of heat by diathermy should decrease the incidence of postoperative pneumonia. It will be interesting to see if this follows.

Crile states that, in his clinic, he is using repeated doses of diathermy *after* operation in feeble and aged patients, the dose being delivered through the bases of the lungs, this being where postoperative pneumonia begins.

If it is not especially desired to deliver the dose through the bases of the lungs, the terminals may be applied to the feet and the temperature of the whole organism maintained, thus promoting circulation and general metabolism. By means of a special carrier, the terminals may be applied before the patient leaves the operating room and the apparatus wheeled with him to his bedside.

The application of radiant heat energy by means of the Alpine or quartz mercury vapor lamp has been found effective by Crile in the treatment of the anemia and cachexia of patients whose general resistance has been lowered by wasting diseases.

The use of diathermy and of radiant heat energy in the treatment of certain conditions is not new, but, as Crile says:

> By the application of these two physical methods, which have long been used by the physiotherapist in certain conditions, the surgeon has increased his armamentarium for the effective treatment of bad-risk patients, especially for the bad-risk abdominal case.

CALCANEAL SPURS

Most medical men, when they find one of these extremely painful and troublesome growths, immeditely jump to the conclusion that the patient must at some time have had gonorrhea. As a result of the usual teaching in medical schools, the impression is gained that gonorrhea is the one and only cause of painful heel. That this is not true is stated in a short paper on "Calcaneal spurs," by Philip Lewin, M. D., of Chicago, which appeared in the January, 1926, number of Archives of Surgery.

According to Lewin, the factors which may be involved in the production of calcaneal spurs are:

First, focal infections with the ordinary cocci, gonococci, and spirochetes; second, metabolic disturbances, especially of gastro-intestinal and gall bladder origin * * * ; third, trauma, due to injury and improper shoes; fourth, static, due to flat feet; and fifth, a pathologic condition of the plantar fascia—a short plantar fascia pulling on its attachment to the os calcis.

The formation of the spur is due to proliferation of the osteogenetic layer of the periosteum. This is brought about by a "slight separation or pulling off of the periosteum" at the point where the plantar fascia takes its origin from the tuberosity of the os calcis.

The symptoms of this condition are pain, tenderness, swelling, and limp. The onset is gradual, except when due to an acute infection. "The pain and tenderness are usually in the internal lateral border of the os calcis or at the attachment of the plantar fascia." X-ray examination may fail to show a spur if the condition is of recent origin.

As to diagnosis, the writer tells us it is usually easy and rests between osteoma, flat foot, and arthritis.

The prognosis of complete relief is good if the spur is the only cause of trouble. If there is an arthritis of the foot, removal of the spur will not give sufficient relief. Most patients can be made comfortable without operation, others are not cured by operation. There may be recurrence of symptoms and spur formation in the same or the opposite foot.

Treatment may be operative or nonoperative. Of the latter, Lewin says:

The etiologic factors, the residue of gonococcus infection, infested tonsils or teeth, should be treated if they can be found. The gastro-intestinal condition should be relieved if possible. Weight bearing should be discontinued, and bed treatment, consisting of the application of an anodyne lotion plus fomentations, should be given. * * *

After all pain and most of the sensitiveness have disappeared, plaster of Paris casts should be applied. Proper shoes are prescribed after from two to four weeks of wearing casts. * * * Felt pads are inserted in the shoes to relieve weight bearing on painful areas. The heel of the shoe should be entirely removed and a low rubber heel substituted.

If nonoperative treatment should fail, operation may be resorted to. Operation consists in the removal of the spur by means of a chisel and mallet through an incision along the inner border of the heel. The foot should remain in a plaster cast for about 10 days, Proper shoes containing felt pads are essential. Attention should be paid to the diet if there is metabolic disturbance. Diathermy will be beneficial for an accompanying arthritis.

The author reports two cases of spurs in boys aged 9 and 13 years, respectively, in neither one of which could gonorrhea be considered a factor.

The paper closes with these comments:

It is highly inadvisable to remove calcaneal spurs unless they are the cause of the patient's complaint or unless one feels that removing the spur will give the patient a comfortable foot. The situation is analogous to operating on hallux valgus; after a perfect operation, the patient may still have painful feet, due to conditions outside the big-toe area, such as metatarsalgia."

AN ARTIFICIAL PRODUCT TO REPLACE HISTIDINE

In view of the importance attached to a properly balanced diet and the belief that certain substances—including histidine—supplied only by Nature are essential for growth and development, the experiments in nutrition conducted by Drs. William C. Rose and Gerald J. Cox at the University of Illinois are particularly interesting and may be valuable. These are briefly reported in the Science News section of Science (LXIII: 1625, 1926), and it is from this that the following quotation is made:

The experiments resulted in successful use of an artificial product to replace histidine, which was previously thought to be one of the 20 building stones of protein essential for the growth and development of men and animals.

The fundamental raw materials for the survival, growth, and reproduction of animals have been grouped under four heads; sufficient fat or sugars to supply energy for body heat and locomotion; a small amount of metallic salts; accessory substances, known as the vitamins; and nitrogenous materials containing some of each of the twenty-odd "amino-acids" of which the proteins are constructed.

Hitherto animals fed on artificial diets lacking one or more of the amino-acids failed to develop properly. Doctor Rose demonstrated, however, that experimental laboratory animals reached maturity if, instead of histidine, a substance similar but lacking the characteristic amino group, was eaten.

"This is the first time that a synthetic product, devoid of an amino group, successfully replaced histidine," Doctor Rose explained. "Growth, while not so rapid, was decided."

Presumably the successful substitute, imidazole lactic acid, stole an amino group from other amino-acids in the artificial diet.

The discovery may be of twofold practical significance, it is pointed out. Proteins classed as "incomplete," such as gelatin, which lacks three of the essential amino-acids, may be rendered adequate from the nutritional point of view by the addition of relatively simple compounds. Again, future economic or agricultural conditions may render it expedient to manufacture food proteins instead of waiting for the process to be carried on naturally by plants. In such an event the synthetic chemists now know that substances approximating, but not duplicating the natural materials, may be adequate for maintaining the health and functioning of the body.

The report is of particular interest in view of the fact that histidine is a constituent of nearly all common proteins and as such has been regarded as fundamental.

PREVENTION OF FIREMAN'S CRAMP

Because most of the ships of the present-day Navy are oil burners, heat cramps do not play so large a part in causing sick days and loss of time among the fireroom personnel as formerly. However, we still have some coal burners and even on oil burners heat cramps are not unknown, so a simple method of preventing their occurrence is still worthy of consideration.

In the Medical Press and Circular for October 7, 1925, A. Vavasour Elder writes of "'Fireman's cramp' and its prevention."

Doctor Elder's attention was caught by an article written by Sir Josiah Court in which he stated that "'Miner's fatigue' is due to a loss of saline content of the blood through excessive perspiration while working in a moist and heated atmosphere. The condition is relieved by replacing this loss in the form of common salt added to the water drunk while at work in the mine."

Firemen on board ship labor under conditions similar to those found in mines, and what is true of miners is also probably true of firemen, and what will be of benefit to one should also help the other.

Elder, believing cramps to be due to the loss of salt, possibly supplemented by "shock" to the gastric nervous system induced by drinking ice-cold fluid, decided to experiment along these lines. The greatest problem with which he was confronted was the introduction of salt into the drinking water without letting the fireroom force know of its presence, as he feared they would not drink it if they knew it contained salt. Tablets of compressed sodium chloride were used and called "cramp preventers."

According to the writer the effects were excellent. During the first trial (June–July, 1925) no cases of cramp developed. The tablets becoming exhausted, he made up a solution of common table salt, 3 drams to the ounce, and added 1 ounce of the solution to every gallon of drinking water. This gave a dilution of about 1 in 425 and caused an almost imperceptible brackish taste. This method was just as successful as the use of the tablets had been.

Three trials were made—all in hot weather—and, among a stokehold complement of 72 men (24 per watch) no cases of heat cramp develeoped, whereas formerly there were three or four cases on every watch.

In the words of the author: "As the outcome of these three trials I am satisfied that the distressing complaint of 'fireman's cramp' can be relieved, if not entirely prevented, due consideration being given to the personal factor, by the use of three drams of common salt to the gallon of water at all times when the stokehold temperature (coal-burning ship) gets unduly hot, especially with a high relative humidity such as is found in the Red Sea and Indian Ocean,

particularly in monsoon time. Ice should, of course, be eliminated as much as possible. Furthermore, this method allows the men to drink ad lib. at times when it is most acceptable."

Elder also considers the advantage of using sugar in the water and the checking of excessive perspiration by therapeutic measures, but favors the simple method of adding salt alone, which he has found safe and satisfactory.

The method, because of its simplicity, if for no other cause, is worthy of trial, and it will be interesting to see how much suffering and loss of time from work will be prevented by its adoption.

NERVOUS CONTROL OF LEUCOCYTIC ACTIVITY

Ernst F. Mueller, M. D., of New York, working in the department of dermatology and syphilis, Columbia University College of Physicians and Surgeons, has succeeded in demonstrating striking and interesting facts concerning the relationship between leucocytic activity and the involuntary nervous system and that the old idea of chemotaxis does not explain leucocytosis. His findings are published in Archives of Internal Medicine (37:2, 1926) and are summarized as follows:

The number of leukocytes found in any vascular region of the body depends on the balance of the involuntary nervous system in this particular region. The leukocytes will be evenly distributed so long as the involuntary nervous system, vasodilators and vasoconstrictors are in normal balance. The uniform distribution changes immediately if there is an overbalance in either direction. Such an overbalance never takes place in the entire body. If large areas are involved, peripheric and splanchnic regions balance each other. An overbalance of the sympathetic, vasoconstricting portion causes local leukopenia, while overbalance of the parasympathetic, vasodilating part causes leukocytosis. Nervous action is always the primary cause of leukocytic activity as far as accumulation and decrease are concerned, even though the leukocytes are in no way directly connected with either the walls of the vessels or with the vaso-controlling nerves of the involuntary nervous system. This knowledge may furnish a new link connecting immunity and body resistance (of which the leukocytic activity is only one part) with the teachings of pathology and physiology in the human economy.

THE GERMICIDAL PROPERTIES OF SOAP

Since 1924 John E. Walker, of the Army and Navy General Hospital, Hot Springs, Ark., has been conducting experiments to determine the relative germicidal properties of various soaps. The most recent report of his results is published in the Journal of Infectious Diseases (38:2, 1926) and contains much of practical value. The conclusions reached as a result of his experiments are quoted in full:

The meningococcus is killed in 2½ minutes by N/80 to N/640 solutions (0.4 to 0.04 per cent) of the soaps of the fatty acids ordinarily present in soap bases; 1 per cent phenol is required to kill under the same condition.

The gonococcus is killed in 2½ minutes by N/640 to N/5,120 solutions (0.04 to 0.006 per cent) of the same soaps; 0.5 per cent phenol killed under the same condition.

Sodium resinate also possesses marked germicidal activity toward these two organisms.

The meningococcus, on being tested with four commercial soaps, showed approximately the same degree of susceptibility as would have been anticipated from the action of the chemically pure soaps.

The susceptibility of meningococci and gonococci is such that they (along with streptococci, pneumococci, and diphtheria bacilli) will be readily killed by any ordinary soap used with a reasonable degree of care.

The dysentery bacilli and paratyphoid bacilli react to the different soaps in the same manner as previously shown for typhoid and colon bacilli; that is, they are killed by moderate concentrations of the soaps of the saturated acids, but are completely resistant to the soaps of the unsaturated acids at ordinary temperatures.

The most readily available commercial soap to be used against the typhoid bacilli, paratyphoid bacilli, and dysentery bacilli is salt-water soap prepared exclusively from coconut oil.

RESIDUAL EFFECTS OF WARFARE GASES

The importance of increased knowledge concerning the residual effects of warfare gases has been recognized by the United States Veterans' Bureau, whose director has appointed a board composed of distinguished medical officers to conduct a thorough study of the subject.

The present status of some 70,000 men whose records show that they were gassed during the war will be studied to determine the character of any defects which might be attributed to the gassing.

The board wishes to obtain the opinions of clinicians who have had experience with these cases and will appreciate it if readers of the BULLETIN will submit to it any information or data on the after effects of gassing they may possess.

A recent letter from the Medical Director of the Veterans' Bureau states that the board is not concerned with the immediate effects of war gases, but desires information on these points:

1. Does any war gassing received in action result in disability which is relatively lasting and permanent?
2. Does it cause lasting anatomic (pathological) changes, with or without disturbance of function (symptoms and disability)?
3. What organs or systems may thus be permanently affected or disturbed?
4. What symptomatology may exist under these circumstances?
5. If war gassing does produce relatively permanent effects, may a similar condition or conditions be produced by other agencies (diseases such as influenza, tuberculosis, effort syndrome, etc.)?

Any information or opinions given to the board will be for official use only and will not be used in any other way without the consent of the one submitting them.

The board will be glad to receive two reprints of any article which any of our readers may have written upon this subject.

DANGERS OF THE COMMON DRINKING CUP

Now that the season of copious drinking of water, soda, ginger ale, and various other soft drinks is at hand, it seems fitting that medical officers should have their attention called to the danger that lurks in the common drinking cup. Of course, all medical officers are aware of this danger and avoid it in their own practice. However, it is a regrettable fact that in many wardrooms one or two glasses do duty all day long for 20 to 30 officers. This should not be, and it is the duty of the medical officer of every ship where this ancient custom prevails to do all in his power to correct it.

The enlisted men on board ship are better off in this respect than the officers because of their very general use of the scuttle-butt. Even they, however, frequently go ashore and, it is to be feared, are not so careful as they should be to use clean glasses when drinking.

Medical officers can do much to lower the incidence of disease among the crews if they will explain the dangers of the use of the common drinking cup and warn against it.

The diseases that may be transmitted in this way are legion, and it is impossible to calculate the number of sick days or even deaths that may occur as a result of the carelessness of people in this respect. Medical officers know the facts and we feel sure that merely calling their attention to the importance of warning other officers and enlisted men will result in a reduction of disease among the Navy personnel and thus improve the record of the Navy so far as preventable disease is concerned.

AMERICAN MEDICAL ASSOCIATION'S MANUAL ON PERIODIC EXAMINATIONS

Recently there have been distributed to certain ships, hospitals, and stations, copies of the American Medical Association's pamphlet, "A Manual of Suggestions for the Conduct of Periodic Examinations of Apparently Healthy Persons." It is intended by the bureau that these manuals be studied by the medical officers receiving them as an aid to conducting in a satisfactory manner the annual physical examination of officers and that they shall be kept in the files of the medical department activity concerned, so as to be always available for reference to all medical officers taking part in the conduct of these examinations.

The blank forms contained in this manual are in no way considered superior to the forms in use by the Navy and it is not

intended that they shall be substituted therefor. However, the manual gives details of the examination, reasons for carrying out certain procedures, and much excellent advice to be given the person examined when defects are found or there is reason to suspect that his mode of living will lead to future defects. For these reasons, it has been considered advisable that the information contained in the manual should form part of the knowledge of all naval medical officers.

A SIMPLE STAIN FOR TREPONEMA PALLIDUM

Dark-field examination of serum from suspected chancres is not always possible. Therefore, a simple method of staining which would in all cases make it easy to find *Treponema pallidum*, when present, by ordinary microscopical examination would be of real value.

In the Military Surgeon for March, 1926, Capt. E. Blackshear, Medical Corps, United States Army, claims that a 2 per cent aqueous solution of gentian violet will stain not only the ordinary mouth organisms, including Vincent's, but also the syphilitic spirochete.

His method is as follows:

1. Dry smear on ordinary slide.
2. Cover with solution.
3. Steam gently one minute.
4. Pour off stain and dry with blotter (do not wash).
5. Examine, oil immersion.

SMOKE GASES ON SHIPBOARD

A number of years ago there was occasion for the Bureau of Medicine and Surgery to investigate the possibility of contamination of the air in turrets by powder gases. It was learned that it was a question of turret ventilation, and since then this condition has been remedied. At that time an investigation of the air in the fireroom suggested the possibility of contamination by CO from smoke gases. During the past year a study has been conducted on several types of ships, both oil and coal burners, to determine if there was such contamination under the usual steaming conditions, and also to learn if there was any basis for the apparent anemia of the fireroom personnel. The suggestion has been made that the pallor of men who serve below decks might be due to the lack of actinic rays. An analysis of the reports submitted show that there is no anemia of the fireroom personnel by actual blood count and that their physical condition is equal if not superior to that of the deck force. By

means of the Sayer apparatus, special examinations of the blood for CO were made after varying hours of exposure in the fireroom. No trace of CO was found in any case. Examinations of aviators were also conducted to determine if there was any contamination of the operating personnel from the exhaust gases. No trace of CO was found in the blood. Negative information has its value as well as positive. The bureau desires to thank the medical officers who conducted this research, not only for the extra time and effort thep gave but also for their prompt cooperation and intelligent interest in the project.

MEETING OF DENTAL ASSOCIATION AT NAVAL HOSPITAL

On May 4, 1926, there was held at the United States Naval Hospital, Norfolk, Va., a joint meeting of the Virginia Tidewater Dental Association and the dental unit of the hospital. An elaborate program of essays, clinics, and recreation periods was carried out in a most creditable manner.

Much good can result from such meetings, and the dentists of Tidewater, Virginia, and the staff of the hospital are both gainers from the interchange of ideas and points of view which took place at the Norfolk meeting.

The commanding officer and the dental unit of the hospital are worthy of commendation for their initiative in organizing the meeting and of congratulations upon the great success that attended their efforts.

NEW BOOKS AVAILABLE

The bureau has approved the addition to the list of books available at the United States Naval Medical Supply Depot for issue to naval hospitals, upon approved requisition, of the following books:

Clinical Diagnosis and Symptoms, by Alfred Martinet, M. D., Paris, France. Translated by Louis T. de M. Sajous, B. S., M. D. Second edition. Two volumes. Published by F. A. Davis Co., Philadelphia.

Internal Secretions and the Principles of Medicine, by Charles E. de M. Sajous. Tenth edition. Two volumes. Published by F. A. Davis Co., Philadelphia.

Applied Biochemistry, by Withrow Morse. Published by W. B. Saunders Co., Philadelphia.

NURSING IN THE NAVY [1]

By HANNAH M. WORKMAN, Chief Nurse, United States Navy

In undertaking to write a paper on Navy Nursing, one is confronted with the task of condensing the material in order to give prominence to outstanding facts. As in all other fields of nursing activities, there are pros and cons to be considered by the individual pondering about accepting an appointment in the Navy Nurse Corps.

It should be remembered that physical well-being is of large importance because the corps is a part of our national defense; therefore persons forming this personnel must be fit and in condition to comply with the requirements which such service may demand. I would state that demands upon physical well-being are not, on the whole, so wearing as in many other fields of nursing. Perhaps the period of tropical duty is rather trying on some physiques and temperaments, but if, while on such service, the nurse's health shows too great signs of strain due to climate etc., orders to return to the States are issued by the medical officer, transportation is provided, and proper rest and care in the hospital until the nurse is fit for duty again. I would also state that the percentage of ill effects due to tropical duty is negligible. Tropical duty in most cases is a very interesting year or two in a nurse's experience. There are some who do not find it so, but that does not alter the fact that tropical stations are very interesting places. It merely means that some individuals do not find them so and those who do not are not to be adversely critized, for is it not in the variability of likes and dislikes that humanity is interesting?

The consideration that the Navy's patients are almost exclusively men acts as a drawing card. We all know that on the whole men are more easily made comfortable than women.

The position of staff nurse on the ward is that of dignity and authority toward the hospital corpsmen who occupy the position of pupils under training. The staff nurse must be just as ready to roll up her sleeves, so to speak, and give assistance to the corps-

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[1] Paper written upon request of the California State League of Nursing Education and read at the Senior Vocational Conference at Merritt Hospital, Oakland, Calif., on Dec. 10, 1925, and published in The Trained Nurse and Hospital Review, April, 1926.

men on her ward as is the nurse in charge of a group of pupil nurses in a civil hospital. Our hospital corpsmen get their practical training and experience on the land hospitals' wards, for only transports and hospital ships carry nurses. The nurses must be careful not to deprive the corpsmen of the handling of difficult cases nor of too much ward management, otherwise when the corpsmen are detailed to sea duty, they would not be capable of meeting the emergencies which they must face in caring for injuries and acute illnesses.

The Navy nursing activities may be somewhat different from those of civil life and sometimes nurses new in the service have trouble in keeping busy until they have grown accustomed to the peculiar conditions governing Navy hospital wards. Later they will wonder how they ever could have thought the wards were not busy places.

Change is, of course, constant; at least one is more or less on the move always, though the average length of duty at a station is about two years. Change of station is a good feature, for it gives travel opportunities and chances to see a fair bit of the world, also occasion for forming new associations and the reunion of old ties. The "hominess" of the Government quarters in which nurses live is the joy of the corps. The houses are comfortably furnished and the newly constructed ones leave very little to be wished for in the way of conveniences. Some duties are in places where there are no Government quarters available; then nurses are given money to cover expenses of food and quarters. The nurses quite enjoy this form of living as a pleasant change from the usual community life. The regularity of the hours, both on and off duty, give great satisfaction. It is a boon to a business woman following a profession to find herself released from her duties at 3 p. m. or to find she is not obliged to attend to business until 3 p. m., and to enjoy having an occasional Sunday free from any duty whatsoever. This arrangement gives the individual time to live as well as providing the means of livlihood.

The salary for the first three years—$70 a month—sounds rather discouraging to all nurses who are contemplating entering the Navy service. We acknowledge it is small. But if the individual stops to do a little calculating, she will find that not many nurses have an amount of $70 a month with clockwork regularity in their hands clear of all living expenses, as the Navy nurse has on the first pay period. To live in the degree of comfort that we do would cost considerable per month and, in addition, we rate hospital care and medical or surgical attention with all necessary drugs, nursing, etc., and our pay does not stop during a sick period. Some of our nurses

have been sick an entire year and throughout the year have received full pay each month. We also get a month of sick leave, if necessary, with full pay, in addition to our yearly leave, with pay, of 30 days; so, when considered altogether, the pay could be worse. At the completion of each period of three years of continuous service, an increase is granted, the maximum being reached at the end of the ninth year, when the staff nurse will be drawing $130 a month. A chief nurse receives $50 a month over and above staff nurses' pay.

There are 70 chief nurses in the corps and promotion of others occurs when vacancies arise in the body of chief nurses. The money return at first does sound small, but, seeing that it is clear of actual living expenses, and that the hours of daily duty are but eight, and that each nurse upon being accepted into the corps receives a complete uniform outfit, the small salary is somewhat compensated. Of course we are not satisfied with it and are hoping it will be raised again in the future, especially the first pay. A bill has been passed in Congress giving nurses retirement after a specified number of years' service. This naturally gives a feeling of peace and security for the later years of our lives.

Thus far I have tried to deal with the practical side of Navy nursing, realizing that the business side of a project is of utmost importance. I believe the majority of Navy nurses when once settled to the idea of remaining permanently in the service find it a most pleasant field of occupation, with congenial associates, and on the whole, pleasing circumstances.

Sometimes we think we are cut off from our former civilian interests, and in a measure we are, but, in exchange, we get a world of enviable experience, and I would add that after observing and chatting with women in other fields of nursing and the various professions and vocations which women take up, we Navy nurses are no more worn into ruts by our work than they are in theirs. They feel, too, that their particular line of business wears them into ruts also, for one can not give one's entire attention to any one line of work without losing out on some experiences. Business men are well aware of this fact too. Our Navy ruts stand an opportunity of being roads, almost, due to our constant shifting from one side of the continent to the other, up and down its coasts and out to its possessions, also due to the fact that we have enough leisure in which to have a "look! see!" all about us, no matter where we are stationed.

We are accused of leading an easy life, of lacking ambition, and some have gone so far as to say we have sought Government employ because we are failures elsewhere. Those who think this are wrong. I grant that we do not work long hours nor overtime to any extent unless in emergency. The service demands fitness, and that condi-

tion can not be secured and maintained if irregularities and irritations are indulged in. We feel that we work under the system that civil hospitals are striving to attain for their nurses, and it is a system which gives the best possible results to patients and personnel. As to the charge of being ambitionless, I honestly think that Navy nurses indulge their ambitions much more than other groups of nurses do, for they have the time and are not overworked. As a fact, it is known that some of our nurses are short story writers, some develop musical talent, some take up public speaking, some interest themselves in business affairs and philanthropic concerns, and others just waste their time. Last though not least, a number constantly realize their matrimonial ambitions.

Of late years the Bureau of Medicine and Surgery has been offering special courses to the nurses. A goodly number have availed themselves of summer work at the various universities, also courses in anesthesia, dietetics, physiotherapy, and laboratory technique. The courses fit the nurses to fill much more capably the various details assigned to them. A Navy nurse is called upon to fill so many different positions from time to time that, like officers, she must be a "Jack of all trades" as well as master of one. So, though we are somewhat apart from actual civil circumstances, we do progress consistently.

It may be seen that with educational advantages, travel opportunities, and enough of leisure time to think and live, and a steadily increasing salary with comfortable housing conditions, the Navy Nurse Corps has considerable to offer to those who appreciate these mentioned advantages. As to being regarded as failures and having found a berth in Government employ, no answer is required, for it is generally conceded that more character is required in an occupation which does not drive than in one which allows no time for leisurely thought. Satan is always hovering near the partially idle and to keep up to the required standard at times takes more actual conscious effort than in an occupation where the rush of work gives no chance for deliberation. We can't always live keyed up to war excitement, and the years of peace are apt to become a bit monotonous and develop mental indifference if not sturdily fought off.

No doubt nurses lacking in desirable qualities do become incorporated in the corps, in fact I have heard nurses say they came in to have an easy time, and it would be an unusual organization that did not have a few misfits. But those who do not measure up to the standard find their way out again, and, of course, there are others who frankly admit they do not care for Government service at all.

Each nurse has an efficiency slip made out quarterly and sent to be filed in the bureau in Washington, D. C. If she falls to the grade of 3, she is urged to improve her status before she is further reduced to the grade of 4, when she can expect dismissal from the corps. Upon improvement, she can be and is raised in grade and retained.

PSYCHOPATHIC NURSING IN THE NAVAL HOSPITALS

By CAROLINE B. DRISCOLL, Nurse, United States Navy

Psychopathic nursing in our naval hospitals is a somewhat different problem from that of the civilian hospitals. The military atmosphere which it is necessary to maintain for the continued use of the Navy personnel is a disadvantage in treating these cases. During the last four or five years, however, we have accomplished much, generally adapting our methods to their needs, with considerable success. Although we at all times have a few of the service men in these departments, most of the patients come to us from the Veterans' Bureau. They come as a rule for a short period of time for examination and observation, and are disposed of according to their needs. The service men usually respond easily to the atmosphere of the ward, and cause little trouble. They are improved by the enforced relaxation of the time spent with us. Contrary to the general opinion, the psychoneurosis wards are, as a rule, quieter and more harmonious than some of the other wards. The tried service man adapts himself to its environment rather quickly, and his nervous condition is usually improved. He then becomes a useful person in the ward. Occasionally we find an exception to this rule, and the freedom enjoyed by others only aggravates his condition; then we have difficulties.

While the nursing care of this type of patient does not differ in some ways from that of the ordinary medical case, yet in many ways, it does. All are given the routine examinations upon admission, and for a short period a chart is kept for recording temperature and clinical details, but the medication is of minor importance, so we have to think of other methods of helping one who is presented to us as a sick man. While not sick enough to be in bed, he has various complaints which have to be followed up and observation often reveals conditions which sometimes give light that leads to some definite pathology. Scientific research in this work by our leading psychiatrists has given us a long list of medical terms for various diagnoses, but the nursing care differs little. The ever-present epileptic, the occasional paresis and dementia præcox cases, do not remain with us long after diagnosis is confirmed. The psychic per-

sonality and anxiety neurosis in its various phases make up the largest proportion of our work. In some hospitals it has been possible to separate the epileptics, thereby eliminating some of the cause of excitement and disturbance in the other cases. Hysteria is, of course, ever present, and is always more or less affected by the attacks of the epileptics.

The location of the ward or wards for this work can not be ignored. Most of the patients are morbid and melancholy but do respond unconsciously to any kind of cheer. The group of small white cottages at the Great Lakes station, with the outdoor surroundings of trees and flowers, and with the possibility of outdoor activities, is worthy of mention. These wards are attractive and clean inside and have a very home-like appearance. Any addition in the way of plants, flowers, or books helps to create a general feeling of contentment.

The selection of the personnel is very important. I think these patients often come to us with a feeling that we are not interested in them, that we often look upon them, as they express it, as a "gang of nuts." The reaction is of course antagonistic. Most of them have been in hospitals before, many of them continually. They are familiar with the hospital routine and vernacular, and use medical terms freely and often ridiculously. They have been told so many things that they are sure there is something mysterious about their particular malady. The most successful of our ward officers in this branch of work are those with a broad sympathetic understanding of human nature, and to them is due much of the success in this work. One officer whom I know always has most interesting sick calls. Much time is given to the individual case and the patient beams to feel that the doctor is sincerely interested in his particular case, and takes advantage of it. As this particular officer has a keen sense of humor, he always saves the day by a clever joke which is enjoyed by all, even the patient. I have many times seen a patient come to us with an attitude of general despondency and apprehension of everything, and gradually change to a cheerful, helpful worker in the ward through the leadership of or association with a cheerful, tactful hospital corpsman.

The therapeutic treatments are mostly physiotherpy and occupational therapy. Of course there is little difficulty in accomplishing the physiotherapy, but the occupational therapy is not always so easy. The patient often feels that if he is considered able to work, he is not sick, and it requires much encouragement to arouse his interest. The surgical patient is often glad for this opportunity of passing away the time, as also are many kinds of medical cases, but the patient of psychic personality feels too much worried about his condition, and many times it is hard to get him started. How-

ever, many do improve when they become interested. Then there is always the possibility of some sociological problem to consider, sometimes economic, sometimes a family difficulty. If discovered and reported to the social service worker, she in turn may be able to assist, thereby relieving the patient from worry and anxiety. This helps a great deal in the general health of the patient. I think there is no branch of nursing that requires so much cooperation with the social service department as that of psychoneurosis.

As the psychic personality has become one of the great problems of community life, from a medical point of view, it is of great importance that we do our part in helping to place back into the community at least a portion of the man power of our country that has become disabled in this way. To many, this branch of nursing appears dull and uninteresting. It lacks the opportunity for development in technique and gives little action. The occasional seizures of the epileptic or hysteric are often interesting, but to many become tiresome after a while. Results appear invisible. It is a great field for the person who is interested in the psychological processes of human nature, and among the patients of psychic personality are many intelligent men, who, through lack of opportunity and inability to adjust themselves to circumstances, have become a prey to all the misery of neurasthenia. However, there is often a spirit of great sociability and cooperation among them and some of them form quite a family group.

There is also among these cases the mental defect, who in many ways is a child among us. He has his periods of antagonism, but will often become helpful in the care of others. With these different types, one learns many lessons in self-control, and the experience among them is not time wasted.

THE IMPORTANCE OF PSYCHOLOGY IN SCHOOLS OF NURSING[1]

By Maude B. Muse, R. N., Instructor, Nursing Education, Teachers College, Columbia University, New York City

The really successful nurse, like the successful doctor, preacher, lawyer, and teacher, is the one who, in addition to a knowledge of her profession, understands human nature. The ability to get along with people is a valuable asset in any profession, but it is essential to the nurse. The records of many training schools show that the occasional nurse never did learn to cooperate and her postgraduate experience is always a series of tragedies. Why was she graduated? Probably because she passed her examinations and was "good with

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[1] Excerpts from an address given at the convention of the National League of Nursing Education, Minneapolis, Minn., May, 1925.

her hands." Even though the nurse is possessed of superior skill and able to put through any amount of hard work, if she is unable to get along with people she is always a failure as a nurse. Her own hospital frequently refuses to employ her as a special nurse, public health nursing is impossible, she does not fit into a doctor's office, and no institution or patient calls her the second time. Psychology early in training, and applied under supervision throughout the course, might have helped this unfortunate individual to make better social adjustments.

In many professions such as pedagogy, law, and the ministry, the human contacts are relatively brief and limited in scope. The nurse, on the contrary, comes in contact with all classes of people, high and low, rich and poor, at all hours of the day and night, and from the cradle to the grave. Also, during illness, well established habit systems tend to be demoralized, strong tendencies are thwarted, and numerous mental conflicts follow. Certainly all possible assistance in the detection, interpretation, and redirection of such sick room reactions should be eagerly sought and utilized by the well-trained nurse.

Granting that an understanding of human behavior is at least as vital to the successful nurse as to members of any other profession, the youth and inexperience of practically all pupil nurses intensifies their need of such a study. Many a young nurse is making her first contacts with illness. She may never have been ill herself or may not have been permitted to enter the sick room except for a brief visit. With what is frequently a very limited experience, the average nurse can not be expected to realize the demoralizing effects of even a slight illness, nor detect certain maladjustments which delay the patient's recovery.

The nurse frequently begins the study of psychology with the impression that it is an exceedingly profound and mysteriously interesting subject. She may anticipate fascinating hours devoted to an analysis of her own thoughts, impulses and emotions; or hope to acquire an uncanny ability to " read minds " and character. Perhaps she dreams of suddenly gained " will power," ability to " concentrate " and marvelously improved memory as advertised in current literature by several schools of mnemonics in the Sunday supplements. She is often much surprised and a little disappointed that she must begin her course in psychology with a study of the human nervous system, as a first step in an understanding of people and their reactions. She may lose interest during the necessary review of the neurological aspects unless she can be made to see the relationship between these and the subject matter of psychology. What, then, is the nature of the subject matter of psychology?

At the time when Socrates taught "Know thyself" and Aristotle wrote his famous treatise on the "Psychology of the Soul," psychology was merely a chapter in the study of philosophy. In its subsequent development it passed through several stages. As some one has facetiously remarked, "Psychology first lost its 'soul,' then it lost its 'mind,' next it lost 'consciousness,' but it still has behavior after a fashion." Psychology is to-day most frequently defined as the science of behavior. So defined, psychology becomes very comprehensive in scope. It seeks to discover what things human beings can do without learning and what they can learn to do. It considers how people are alike and how they differ. It attempts to classify their numerous activities in some orderly fashion. Because it is "a science," it seeks to evolve scientific laws which will help to predict and explain human behavior and to formulate certain principles which result in economical learning.

"Behavior may be considered to include all the activities of the organism: Actions, speech, emotions, mental activities, glandular reactions or the absence of any of these when they should be present. It is, for instance, very significant behavior which causes an individual to stand still on the railroad track at the sight of an oncoming express. In a similar fashion, absence of normal reactions in the sick may likewise create difficult situations. It is of course most important that the nurse be able to cope with acute delirium and sudden mania in her patients; but it is equally important that she should acquire skill in handling extreme apathy, "mutism," tearless grief or the exaggerated state of indecision which is fairly common after severe illness.

A nurse who has had good courses in physiology and neurology needs but to supplement and to organize her knowledge somewhat to serve as a basis for psychology. Knowledge of the structure of the sense organs and nervous system is, however, only a beginning. Psychology shows the rôle played by the sense organs in the behavior mechanism, and the effect of impaired sense organs or ill-advised use of these receptors upon behavior.

Of primary consideration are those sense organs which are indispensable to the nurse—the eyes. Many nurses "have eyes and see not" while others are credited by patients with "eyes in the back of their heads." The student nurse should be made to see that the difference lies not in the organs themselves but in the connections established between them and the desired responses. Defective vision may often be corrected by the proper glasses; but this is no guarantee that the nurse will "see" the things which she, as a nurse, should see. Specific bonds must be formed before a nurse will be able to take in every pertinent detail of patient and environment at a

glance. This is the reason why many silent witnesses of the patient's discomfort are not recognized as such by the nurse. Patients should not have to ask that blinds be drawn, the light shaded, the ice cap or hot-water bottle refilled, that lips be moistened, tongue cleansed, nor for many of the thousand and one things which mean so much to the sick.

The eyes of the patient also play an important part in the psychology of the sick room. They may be made invaluable allies to hasten recovery, particularly during convalescence. Through them the nurse may obtain a variety of desirable responses which directly affect the recovery of her patient. Florence Nightingale long ago recognized the importance of what she termed "slow variety" during convalescence. To use her own words, "A patient may just as much move his leg when it is fractured as change his thoughts when no external help from variety is given him."

Innumerable ways of attaining slow variety should occur to the nurse versed in psychology. Variety in the serving of meals as well as in the food served, variety in the site chosen for the wheel-bed or wheelchair so as to afford a different view each day, growing flowers, one carefully chosen picture, changed occasionally, are a few of the most obvious methods which a nurse may employ to furnish "slow variety" for a patient who has been for some time acutely ill. On the other hand, a nurse who understands stimulus-response psychology will avoid subjecting the patient to a swift succession of stimuli early in convalescence. She will not place the patient who has been critically ill and is up for the first time, where he may watch the swift movement of a busy street, or even on a veranda or in a sun parlor where many patients are collected and there is much passing to and fro.

Reasons why the nurse must consider sensory stimuli in an attempt to modify the reactions of her patients so as to hasten recovery might be multiplied indefinitely, if time permitted, but two other types of mechanisms demand consideration—the response organs, muscles, and glands and the countless connecting neurones in the cortex of the brain.

The structure and functioning of the muscle effectors are familiar to the nurse, but she is not likely to realize, through the study of anatomy and physiology, the relationship between muscle tonus and strong emotions, for instance; or to recognize the possible effect of general hypo or hypertonicity upon human conduct.

The second class of effectors, the glands, is likewise familiar to the nurse. She may, however, think of them only in their connection with the study of dietetics and metabolic disorders. The dynamic rôle played by the endocrines in regulating human reactions should not be overlooked. It is important, for example, both physiologi-

cally and psychologically, for a person to do something to " work off " the excess adrenin and glycogen which accompany a fit of anger rather than to sit and welter in his own secretions. The story of the ductless glands and internal secretions reads like a fairytale. Indeed, in much of the recent literature dealing with internal secretions, there appears to be the same indiscriminate mingling of fact and fancy which characterizes the fairytales.

On the frontier, as it were, of this little explored glandular territory lies the thyroid. The most readily accessible gland, it has revealed more of its secrets than any of the other endocrine glands and, hence may well be cited to illustrate the behavior aspects of gland functioning. Patients suffering from excess thyroxin are nervous, excitable, fearful and highly emotional. Ecolalia, mania, and melancholia may appear in extreme cases. Any stimulus may become a new source of worry, anxiety, and apprehension. For this reason, the nurse should recognize the psychological implication of a routine day of clock-like regularity for the exophthalmic goiter patient. The most successful treatment is, of course, surgery at the hands of a skilled and experienced operator, but most surgeons frankly admit their dependence upon the type of nursing care which precedes and follows the operation. A nurse might well specialize in the study of the psychology of the exophthalmic goiter case.

A superficial survey might suggest the possibility of many disorders of the motor and glandular " reacting mechanisms " which are evidenced in behavior. In the larger per cent of the cases, however, the trouble is located not in the response organs, but in the third portion of the behavior mechanism, the great central adjustor, which the nurse knows as the central nervous system.

Behavior should be interpreted to include, besides words and deeds, certain responses which most of us tend to rank high in the scale of importance, namely, mental and emotional reactions. Tears, moans, restless movements, are no more significant forms of behavior than silent fear, motionless resignation, sullen revolt, hopeless acquiescence, or demoralizing worry.

Knowledge of the external expression of the various emotions can not be taught in a lecture or book. It is to be gained only by close observation of many people. A course in psychology, however, early in training, should greatly assist the nurse in detecting symptoms of strong emotions among patients who often wear a mask but tattle with their finger tips, restless feet, or bodily attitudes. As a rule, patients should be safeguarded against strong emotions. Few people need to be told the effect of strong emotion upon appetite, digestion, and elimination. More scientific evidence than that afforded by subjective experiences is available, however; X rays of a cat while digesting a meal before and after being worried by a dog give conclusive

proof of the effect of excitement upon digestion. That nurse labors more intelligently to secure a rapid convalescence for her patient who recognizes that one essential is to keep the strong emotions out of the sick room. Just as she will protect her patiént from physical strain, so she will try to keep the patient free from emotional strain, including as a rule even pleasurable emotions which are too exciting.

The nurse versed in psychology will recognize why the organic states like anger, fear, and excitement, set up in response to a certain stimulus may persist long after the reaction to the stimulus has disappeared, and predispose the individual to make a similar reaction to slight stimuli which would not ordinarily get that response. A certain hospital patient, for example, on "general care" was so upset if the attending surgeon and staff made rounds before she had shed her curl papers and donned her pink bed jacket that she would not get over it all day. Her exasperation and anger would fade but the nurses soon discovered that nothing could be done to please her for many hours, while on other days she was easily satisfied. The reaction of this patient should be recognized by the nurse as due to the blocking of a strong personality trend which could not fail to be annoying tò the patient. Human beings are born with numerous tendencies to react in certain ways and are likewise born to like some of these reactions and to dislike others—to be pleased by some and annoyed by others. The "original annoyers" are practically all to be met in the sick room. Physical pain, bad odors, bitter medicine, slimy things (like green soap plasters), solitude, depression, unfamiliarity—all are there. It will tax the ingenuity of the nurse to include many "native satisfiers."

The nursing implications are numerous. People when ill are of necessity thwarted frequently and in numerous ways. By original nature they tend to react to thwarting in a fashion which may delay recovery. No matter how "reasonable" they may try to be, thwarting tends to arouse a strong emotional response and thus interrupt the vegetative processes so necessary for convalescense. The nurse who is a student of psychology will realize that most people are natively endowed with a strong tendency to self-assertion. She will recall how thwarted self-assertion breeds sulkiness, peevishness, stubbornness, etc. When such untoward reactions do appear in her patients, she will attempt to discover if the self-assertion of her patients has been unnecessarily thwarted and if so she will assume some of the blame herself.

It is seldom possible for the nurse to know beforehand the peculiarities of disposition and character of the series of patients under her care. In this respect the old-fashioned general practitioner has few equals to-day. He was personally acquainted with every member of the small rural or urban neighborhood in which he prac-

ticed; he knew all their peculiarities and idiosyncrasies and those of their families and forebears. He had their implicit confidence. He knew just when it would be wise to conceal the serious nature of the case and when he could hope to arouse a fighting spirit which would help to win against disease. He knew which case could be influenced by subtle suggestions which would assist nature and the simple drugs he used to work a cure. The nurse can not hope to understand her patients as thoroughly as did these fine old-fashioned "doctors" who are gradually making way for the modern specialist. She is seldom acquainted with her patients before their illness and frequently loses contact with them directly after recovery. She can, however, learn to recognize certain personality types; she can always keep in mind that no two people are alike in their reactions to environment and can take measures to adjust hersef to their outstanding differences. She can also alter the environment of the sick room so as to secure the response which will best assist nature, and the physician or surgeon in restoring the patient to health.

This greatly to be coveted ability to understand and to influence people, to predict and alter human behavior, may sometimes be acquired by years of experience. It may, on the other hand, never be acquired at all. There can be no doubt that every effort should be made to build it up under guidance during training.

Before the nurse can do much to help her patients she must herself have made satisfactory adjustments to an absolutely novel environment. A knowledge of psychology should be of great assistance in helping her to fit into the new life of the hospital situation. Numerous maladjustments are revealed in the following plaints which will sound familiar to those closely associated with young nurses. "I worry so much about my patients that I can not sleep nights." "I just can't take orders from that senior—why, she is younger than I am." "I have not studied for years and I've quite forgotten how," etc.

The nurse needs psychology also because she is a student. Few students anywhere are expected to cover so much and such a variety of strictly new subject matter in so short a time as is the student nurse in the preliminary period of her training, and this probably with a certain handicap of physical fatigue. It is true that a course in psychology does not always insure good teaching or guarantee economy in learning. A study of everything ever written on the science of health and sanitation, for example, will not make a man any healthier unless he uses his knowledge to improve his habits of personal hygiene and the condition of his environment. Mastery of the facts and laws of psychology alone will not make for economy in learning. Improvement may be expected only when such knowledge is used to establish good habits of study and when opportunity is afforded for the exercise of these habits.

The path of experience ("trial and error" learning it is called in psychology) is a very old one and of necessity much traveled between birth and death. It is exceedingly wasteful of time and energy, many of its lessons being learned too late to be of much use to the individual. Modern students should be anxious to use the guideposts and signboards presented by psychology. But guideposts are quite useless unless correctly interpreted and accurately followed. Economy in learning presupposes a reading of the psychological signposts, but imposes the additional obligation of individual activity other than the mere reading and memorizing. Progress along the road of learning means expenditure of individual effort to overcome resistance; and all that psychology can hope to do is to point the right way and indicate the "steep grade" or "dangerous curve." It is a truism that there is no "royal road to learning."

It appears evident, then, that a study of psychology should prove invaluable to the nurse herself. It is safe to predict that an adequate knowledge of the science plus a consistent practice of its teachings would assist greatly in the acquisition of the ability to cooperate with all sorts of people, subordinates, professional superiors, and colleagues; the ability to conserve time and energy so as to attain the highest degree of achievement; the formation of habits of economy in learning; the acquisition of motor skills and good technique in professional procedures.

The nurse needs psychology in dealing with her difficult patients. The problems which confront the nurse in handling sick people in such a fashion as to further their recovery and insure the minimum mental discomfort while the illness lasts; in managing anxious or interfering friends and relatives, etc., are too numerous and too varied to be listed. The following will be recognized as common and fairly typical problem cases: The patient who stubbornly refused to cooperate; the patient who repeatedly complicates recovery by infringement of restrictions, disobedience of orders, etc.; the officious patient who wishes to determine the character and direct the method of all treatment; the patient whose only association with the hospital is the death of some loved one; the patient who is tired of life; the hypochondriac; the drug addict; the delirious patient; the social derelict; the psychopathic personality, emotionally unstable, suffering from fears and obsessions, hysteria, neurasthenia, etc.; the fractious child; the child with specific bad habits, etc. Obviously few of the cases listed can be handled satisfactorily by the young nurse without specific training. All that modern psychology has to offer to assist the young nurse in "nursing the mind" as well as the body should be recognized as an essential part of her equipment.

BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,
UNITED STATES NAVAL MEDICAL BULLETIN,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.
(For review.)

ABDOMINAL OPERATIONS, by *Sir Berkeley Moynihan, Leeds, England.* Fourth edition, revised. Two volumes. W. B. Saunders Co., Philadelphia, 1926.

This new edition, appearing after an interval of 10 years, is most welcome. During those 10 years there have been many changes in opinions and improvements in methods. It is most interesting and valuable to read the views and the technic described by this author.

Two paragraphs from the introduction are worthy of being read frequently by every one engaged in surgery. "Surgery is not only a matter of operating skillfully. It must engage in its service qualities of mind and of heart that raise it to the very highest pinnacle of human endeavor. A patient can offer you no higher tribute than to entrust you with his life and his health, and, by implication, with the happiness of all his family. To be worthy of this trust we must submit for a lifetime to the constant discipline of unwearied effort in the search of knowledge, and of most reverent devotion to every detail in every operation that we perform.

"Surgery to-day is being practised by too many light-hearted and incompetent surgeons, who have neither sought in due service, to acquire, a mastery of their craft, nor have learned, from the experience gained by long experience in hospital work, when an operation should be done, when left undone, how made safe, how made to fall lightly on a patient already afflicted, it may be, by mental no less than by physical distress."

The character of Sir Berkeley Moynihan and the quality of his writing are such that any of our medical officers who are interested in surgery would enjoy reading every page of these two volumes. One's spare time, spent in this way, would be an immensely profitable investment.

This edition should be in the library of every naval hospital.

YOUNG'S PRACTICE OF UROLOGY, Based on a Study of 12,500 Cases. By *Hugh H. Young* and *David M. Davis*, with the collaboration of *Franklin P. Johnson*. With over 1,000 illustrations, 20 being color plates, by *William P. Didusch*. Two volumes. W. B. Saunders Co., Philadelphia, 1926.

"Why another 'Urology'?" is the opening sentence of the preface of this work. The answer to this question is given in a most convincing *apologia*, in which are listed the achievements of the author and his associates. These achievements consist of various procedures, mechanical devices, medicaments, and original researches which have had their inception with this group.

The arrangement of the subject matter is based on the pathology. In the early part of the book are treated separately all lesions due to obstruction of the urinary tract, which are the same regardless of the cause of the obstruction. The next section is devoted to urogenital infections and infestations. Then follow sections on urolithiasis, benign hypertrophy of the prostate, and neoplasms of the urogenital tract. The second volume has chapters on malformations and abnormalities, traumatism and foreign bodies, ulcerative lesions, and the diagnostic significance of special urologic symptoms. The section on surgical operations covers more than 400 pages.

All parts of the work are marked by definite statements of the author's opinions on controversial subjects, backed up by numerous case reports from the 12,500 which form the background. Historical notes, showing the milestones along the path of knowledge of the various subjects, are numerous and interesting.

Because of the high standing of the author of these volumes, they will hold a certain position of authority from the time of their first appearance. It is apparent, from an examination of the books, that their position of authority will be strengthened by their own excellence. We predict an immediate and permanent success for Young's Practice of Urology.

PARASITIC PROTOZOA OF MAN, by *Charles F. Craig, M. D., M. A. (Hon.), Lieutenant Colonel, Medical Corps, United States Army, D. S. M., late Director of Laboratories and Professor of Bacteriology, Parasitology, and Preventive Medicine, Army Medical School, Washington, D. C., etc.* J. B. Lippincott Co., Philadelphia, 1926.

The volume was prepared by one of the distinguished members of our sister medical service. As the author states, there is no book in the English language that adequately covers the field, hence the need for a book of this sort is obvious.

The volume as a whole is exceedingly well arranged and contains information of the most recent investigations. Each chapter is followed by an extensive list of references, which should prove most helpful to anyone specially interested in further studying certain aspects of this subject.

It is interesting to note that one of our common tropical associates, formerly known as the *Lamblia intestinalis*, is described under *Giardia intestinalis*, a name given it by Stiles in 1915. Dobel claims that this parasite was described in 1681 by Leeuwenhoek, the "Father of Microscopy," who found it in his own stools.

About 150 pages are devoted to a consideration of the malaria plasmodia, and it would, perhaps, have been desirable to include colored plates showing the staining reaction of these and other protozoa. The treatise is otherwise nicely illustrated, with special reference to the photomicrographs taken from the Army Medical School collection.

OPERATIVE CYSTOSCOPY, by *E. Canny Ryall, F. R. C. S., Founder of and Senior Surgeon to All Saints' Hospital for Genito-Urinary Diseases, London.* With 115 plates containing 670 original illustrations, of which 528 are colored. St. Louis, The C. V. Mosby Co., 1925.

This is a most ambitious volume. There are 115 plates, each having 6 separate illustrations, the greater number of which have the details shown in their natural colors. The normal appearance of the tissues through the cystoscope, the appearance of the lesion, and the method of cystoscopic treatment are clearly shown in each case. Each plate is accompanied by an explanatory legend in English, French, and German text.

The book is divided into four sections, titled Anesthesia, Ureter, Bladder, and Prostate. There is also an appendix, in which is described the author's universal cysto-urethroscope.

The plates are excellent; the text is clear and concise. The whole volume combines the useful and the beautiful in an unusual degree.

INTESTINAL TUBERCULOSIS, by *Lawrason Brown, M. D., Chairman of the Medical Board of the Trudeau Sanatorium, Saranac Lake, New York,* and *Homer L. Samson, Röntgenographer of the Trudeau Sanatorium, Saranac Lake, New York.* Lea and Febiger, Philadelphia, 1926.

What proportion of patients with pulmonary tuberculosis have associated involvement of the intestines? To what extent do the intestinal complications diminish the chance of recovery from the lung lesions? Is intestinal tuberculosis a terminal condition or does it occur earlier in the disease? The inability to answer these questions was the incentive for an exhaustive study, the results of which are to be published in a series of monographs, of which the present is the first volume.

The authors' conclusions are here summarized: Intestinal tuberculosis is the most frequent complication of pulmonary tuberculosis, being found in 50 to 80 per cent of all autopsies on patients dead of that disease. Suggestive symptoms of early intestinal tuberculosis include any digestive disturbance, marked constipation, failure of

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the pulmonary condition to improve, an irregular temperature with subnormal fluctuations, alternating constipation and diarrhea, and marked nervousness. The Röntgen-ray study with the barium meal shows general hypermotility, failure of the cecum, ascending colon, and hepatic flexture to retain the barium, ileal stasis, and gastric retention. The barium enema confirms the fact that the cecum and other portions of the colon may fail to receive or retain the barium. This is the only method which will diagnose intestinal tuberculosis in its incipiency or exclude it at any stage.

Medicinal treatment is of little avail except for control of diarrhea. Surgical interference is not recommended for those with advanced pulmonary or intestinal lesions. In early, localized cases, excision or short-circuiting may be done. Ultraviolet rays and natural heliotherapy should be tried in all cases. Many cases make a good recovery, both clinically and radiographically.

We shall welcome the later volumes of this series. Judging by the quality of the present volume, they will prove exceedingly valuable.

The Principles and Practice of Endocrine Medicine, by *William Nathaniel Berkeley, Ph. D., M. D., recently Attending Physician at the Good Samaritan Dispensary, New York, and one time director of the Laboratory of Experimental Medicine, Cornell University Medical College.* Lea and Febiger, Philadelphia, 1926.

The primary object of this book, as outlined in the preface, is to present in a convenient compass some of the underlying principles—and their practical application—for the information of the clinical practitioner.

In order to cover the underlying principles, it was necessary to discuss the anatomical relations, comparative anatomy, and histology of the different endocrine glands. These aspects are, however, briefly and simply described, which fact emphasizes rather than detracts from the practical parts of the volume.

On page 279, speaking of testis grafting, the author says "the question will be more fully discussed under Treatment. (P. 299.)" While on page 299, he says the matter "is considered more fully in the chapter on Gland grafting," a reference to which failed to reveal any extensive consideration of this topic. The "undesirable and premature notoriety" given the "rejuvenation graft" naturally prompts one to avoid giving much space to this question and causes him to adopt a conservative attitude.

The book, as a whole, is well arranged, prepared in simple and concise language, and furnishes a source of information and reference to be consulted by the active physician who is daily confronted by problems more or less closely related to endocrinology. It should be read with interest and profit by naval medical officers.

Aviation Medicine, by *Louis Hopwell Bauer, Major, Medical Corps, United States Army; Commandant, the School of Aviation Medicine.* The Williams & Wilkins Co., Baltimore, Md., 1926.

This book fills a need which has been very great in the military service, since it discusses all of the phases of the medical aspect of aviation.

The author, in an exceptionally clear and readable manner, takes up the various steps in the physical and mental examination of the flyer, describing each special test and discussing the interpretation of the findings. The physiological and psychological effects of high altitudes are discussed, with a description of the altitude classification tests.

The care and maintenance of the flyer by the medical officer are admirably discussed.

The book is the result of the author's wide experience in aviation medicine and is an excellent guide for the physician interested in this subject.

Practical Clinical Psychiatry for Students and Practitioners, by *Edward A. Strecker, A. M., M. D., Medical Director, Pennsylvania Hospital, Department for Mental and Nervous Diseases; Director, Neuropsychiatric Clinic, Pennsylvania Hospital, etc.;* and *Franklin G. Ebaugh, A. B., M. D., Professor of Psychiatry, University of Colorado; Director, Colorado Psychopathic Hospital, etc.* P. Blakiston's Son & Co., Philadelphia, 1925.

This relatively small volume, printed and bound in a most attractive manner, presents between its covers considerably more than a mere introduction to the study of mental diseases. As its title suggests, it is intended for students and general practitioners, but psychiatric specialists will find many points of interest in the case-history discussions. The book contains, in well-balanced proportions, didactic discussion of the various mental diagnoses and studies of actual case histories.

The first three chapters follow the conventional textbook fashion, with a general discussion of etiology, etc, classifications, and methods of examination of cases. This, while presenting nothing essentially new, is written in an exceedingly clear and interesting manner.

The remaining nine chapters consist of the discussion of mental diseases under their respective classifications. The authors place all psychoses in three general groups, *i. e.*, (A) Organic psychoses, including all psychoses in which there is actual brain damage; (B) Toxic psychoses, including all conditions in which mental phenomena are called out in response to a toxic agent; (C) Functional psychoses (psychogenetic), in which group are placed all psychoses that do not involve organic or toxic factors. The case-history method of teaching is emphasized and each condition is well illustrated by case histories of actual patients.

The last chapter contains a short discussion of mental deficiency, with appropriate illustrative cases. The book ends with a glossary which should prove very useful to the student.

Diseases of the Nose, Throat and Ear, by *William Lincoln Ballenger, M. D., late Professor of Otology, Rhinology and Laryngology, College of Physicians and Surgeons, Department of Medicine, University of Illinois, etc.* Revised by *Howard Charles Ballenger, M. D., Fellow of the Chicago Otolaryngological Society; formerly Instructor of Otology, Rhinology and Laryngology, University of Illinois School of Medicine, etc.* Fifth edition. Lea and Febiger, Philadelphia, 1925.

Ballenger's textbook has been for too long a time considered an authority on diseases of the nose, throat, and ear to require an elaborate review. This fifth edition is an improvement on the older editions only in that it has been brought up to date by the inclusion of descriptions and discussion of operations which have been developed or perfected since the fourth edition was published and of newer knowledge concerning the anatomy and pathology of the structures dealt with.

The editor of this edition is conservative in the matter of operating upon the nose and mastoid and his writings are somewhat colored by this fact, thus giving them increased value.

No one engaged in ear, nose, and throat work can afford to be without this latest edition of Ballenger.

Clinical Diagnosis and Symptoms, by *Alfred Martinet, M. D., Paris, France.* Second edition. Translated from the fourth French edition by *Louis T. de M. Sajous, B. S., M. D., Philadelphia.* Two volumes. F. A. Davis Co., Philadelphia, 1925.

This work of Martinet presents the subjects with which it deals in a manner somewhat different from the usual textbooks, in that it stresses the importance of a *complete* diagnosis in all cases and attempts to show how this may be reached. The author states that a complete diagnosis is the sum of four partial diagnoses: (1) Clinical or syndromatic, (2) lesional or pathological, (3) functional or physiological, and (4) causal or etiological. That it is not possible to arrive at this complete diagnosis in all cases is recognized, but this is the ideal toward which one should strive.

A chapter on mistaken diagnoses and their causes is valuable and interesting.

Volume I treats of physical and laboratory methods of diagnosis as applied to the various systems and organs of the body and is most complete. The importance of a thorough physical examination is spoken of and practical suggestions for conducting such are made.

While the author gives full credit to the Wassermann reaction for what it has accomplished in the diagnosis and treatment of

syphilis, he states that it is not a specific test, nor is it always reliable, and advocates the use of the Vernes perethynol method of syphilometry in its place, as this is claimed to be entirely accurate.

The Kahn test is of too recent development to be included in this work.

Volume II is devoted to an analysis of symptoms, all of these being discussed in an adequate manner.

Because the subject is presented in an unusual manner, the book is well written and well edited, and the illustrations are unusually good, any physician will profit by the possession and study of these volumes.

A TEXTBOOK OF GENERAL BACTERIOLOGY, by *Edwin O. Jordan, Ph. D., Professor of Bacteriology in the University of Chicago and Rush Medical College.* Eighth edition. W. B. Saunders Co., Philadelphia, 1925.

Advances in bacteriology require frequent revisions of textbooks and with the appearance of an eighth edition of this standard work of Jordan, we find much new material presented in the same clear and concise form which has characterized each revision of this textbook since its first appearance in 1908.

The recent studies of the bacteriophage phenomena of d'Herelle, tularemia, scarlet fever, and botulism are noteworthy additions to the text. The chapter on anærobes is thoroughly revised.

There is a noticeable absence of the new bacteriological nomenclature adopted by the Society of American Bacteriologists and one readily assumes that the author is hesitant to adopt this radical departure in naming bacterial species.

MEDICAL DIAGNOSIS, by *Charles Lyman Greene, M. D., formerly Professor of Medicine and Chief of Medical Clinic in the University of Minnesota; Chief of Staff, St. Luke's Hospital, St. Paul; etc.* Sixth edition, revised and enlarged. P. Blakiston's Son & Co., Philadelphia, 1926.

Greene's Medical Diagnosis has been a valuable textbook for years. This edition will prove to be no less so. The author has revised his text to conform to present-day knowledge and has added sections which deal with the diseases that have come to light since the fifth edition was published. The practice of italicizing important statements and of using marginal notes to call attention to the contents of numerous paragraphs is commendable and is helpful to the reader. Students and practitioners will find this a very useful book for study and reference.

INTRAVENOUS THERAPY, by *Walton Forest Dutton, M. D., formerly Medical Director, Polyclinic and Medico-Chirurgical Hospitals, Graduate School of Medicine, University of Pennsylvania; Director, Medical Research Laboratories, Amarillo, Tex., etc.* F. A. Davis Co., Philadelphia, 1925.

A book of 594 pages, the first 20 of which are pleasantly taken up with an excellently written historical outline of intravenous therapy. The remainder of Part I deals with various methods of technique of

venesection, transfusions, infusions, etc., and many conditions in which the author considers these procedures justifiable. There are many schematic illustrations of doubtless value. Figure 31, page 132, shows a method of injecting a solution into the femoral vein. In this illustration the needle is introduced through the hair of the femoral region, which is undoubtedly poor technique.

Part II begins with a highly philosophical discussion and plea to "qualified physicians" to familiarize themselves with the technique of intravenous therapy. Following this is a discussion of about 100 conditions in which intravenous therapy is recommended.

The appendix contains the usual metric equivalents.

LUMBAR PUNCTURE, by *Martin Pappenheim, M. D., Professor at the University of Vienna; Medical Superintendent of the Neurological Department, Municipal Infirmary, Vienna.* Translated by *George Caffrey.* William Wood & Co., New York, 1925.

The original German edition of this book covered the substance of the distinguished author's lectures on the subject of lumbar puncture. In the present English edition he has made a number of additions, including an appendix on encephalography and puncture of the cisterna. He gives a very happy personal touch to the book in his very detailed instruction as to the technique. The laboratory methods of examination of the spinal fluid are given in detail and should be of benefit to the general practitioner as well as to the laboratory technician, for the former should understand such reactions as are detailed here sufficiently to enable him to interpret results of institutional investigations when he is informed of the special conditions existing. Much of value to all medical men is contained.

PSYCHOTHERAPY, by *Edward Wyllys Taylor, James Jackson Putnam Professor of Neurology in Harvard University.* Harvard University Press, Cambridge, Mass., 1926.

This one of the series of Harvard Health Talks traces, very briefly, the development of psychotherapy from the beliefs of primitive men in evil spirits to the present day conception of treatment by bringing to the conscious mind facts that have been hidden in the unconscious or subconscious mind.

The author wisely avoids controversy as to the merits of the doctrine advocated by Freud, but calls attention to the fact that through his work and that of others the time when psychotherapy can take its place as a recognized method of treatment has been brought closer. He also stresses the importance of keeping this method in the hands of the medical profession and not allowing it to pass to irregular practitioners. The responsibility rests upon the medical schools.

A careful reading of this interesting short lecture will repay anyone.

Clinical Laboratory Methods, by *Clyde L. Cummer, Ph. B., M. D., Associate Professor of Clinical Pathology, School of Medicine, Western Reserve University; Visiting Dermatologist, St. Alexis Hospital, and St. Vincent's Hospital, Cleveland, Ohio.* Second edition, thoroughly revised. Lea & Febiger, Philadelphia, 1926.

One of the best manuals of clinical laboratory methods that has come to the reviewer's notice. It is comprehensive, yet brief; contains descriptions of all the usual tests and laboratory procedures, presented in such a way as to render them easy of performance by student or clinician; is practical; and has a complete bibliography, which renders it possible for anyone interested quickly to find the authority for the author's statements. Besides, the book is well edited and clearly printed on good paper, thereby creating a pleasing impression on sight.

The Therapy of Puerperal Fever, by *Privatdozent Dr. Robert Koehler, formerly Assistant of the Gynecological Department of the Krankenhaus Wieden in Vienna, Austria.* American edition prepared by *Hugo Ehrenfest, M. D., F. A. C. S., Associate in Obstetrics, Washington University School of Medicine, etc.* The C. V. Mosby Co., St. Louis, 1925.

That the therapy of puerperal fever is in a far from satisfactory state is evidenced by the multiplicty of measures and remedies suggested to overcome the dire results of this condition.

The author of this book has had abundant opportunity to study puerperal fever from its inception to the necroscopy table and has compiled valuable data from his experience.

Prevention still remains the great ideal, for, in spite of advances in surgical and medical treatment of the condition, death still occurs in an alarmingly large proportion of cases.

A very thorough trial of many of the newer forms of chemotherapy, vaccines, and foreign protein injections was made by the author. His results lead him inevitably to the conclusion that a rational form of therapy has not yet been found. He is not hopeless, however, as he believes it possible that along the lines of chemotherapy a truly "etiologic-curative remedy might be discovered."

A System of Clinical Medicine, by *Thomas Dixon Savill, M. D., London.* Seventh edition. William Wood & Co., New York, 1925.

Savill's system has been long and favorably known in England, but in this country is comparatively little known. It is a "system" in one volume and is, therefore, necessarily condensed. For ready reference this is, of course, an advantage. While the book can not take the place of the larger and more complete systems of medicine, it will appeal to both student and practitioner who have not the time to search through the lengthier works for some obscure fact. The arrangement differs from that of any other textbook on medicine

known to the reviewer, in that first place is given to symptoms and from these the cause is sought, while pathology is not given the prominent place it occupies in other textbooks. In short, the arrangement follows the lines of a bedside examination, and close study of the book will be of real help in this important part of the doctor's work.

Taylor's Practice of Medicine, Thirteenth edition, by *E. P. Poulton, M. A., M. D. (Oxon.), F. R. C. P. (Lond.), Physician to Guy's Hospital, etc.*, with the assistance of *C. Putman Symonds, M. A., M. D. (Oxon), F. R. C. P. (Lond.), Assistant Physician for Nervous Diseases, Guy's Hospital, etc.*, and *H. W. Barber, M. A., M. D. (Camb.), F. R. C. P. (Lond.).* P. Blakiston's Son & Co., Philadelphia, 1926.

First published in 1890, Taylor's textbook has required frequent revision to keep it abreast of the rapid progress in medicine and to supply the demand of British students and practitioners for it. In this thirteenth edition are many new articles dealing with endocrine dysfunction, newly recognized diseases and diseases in which increased knowledge has required a revision of ideas concerning them, and new methods of diagnosis and treatment. An innovation is the list of references to the recent literature at the end of the chapters. Most of the references are to British journals.

Ears and the Man, by *Annetta W. Peck, Estelle E. Samuelson*, and *Ann Lehman.* With an introduction by *Wendell C. Phillips, M. D.* F. A. Davis Co., Philadelphia, 1926.

This interesting little book by three women who, themselves deaf, have devoted their lives to improving conditions for their fellow sufferers from this handicap, must prove an inspiration to any reader who finds himself losing his sense of hearing and feels hopeless as a result. Its perusal should also stimulate the otologist, or other medical man, to greater effort to understand the psychology of the deafened and, therefore, to be of greater assistance to these unfortunates, especially to those who can not be benefited by treatment.

Lip-reading is the method *par excellence* by which the deafened may be rehabilitated and rendered happy and useful members of society.

Many examples are given of persons who have found themselves withdrawing from the world on account of the natural sensitiveness which seems to accompany deafness, but who have been able to assume their places as useful citizens because of the assistance given them by the writers of this book and by others who are engaged in this extremity valuable social service under the auspices of some one of the several branches of the American Federation of Organizations for the Hard of Hearing.

A SYNOPSIS OF MEDICINE, by *Henry Letheby Tidy, M. A., M. D., B. Ch. (Oxon.), F. R. C. P. (Lond.), Assistant Physician to St. Thomas's Hospital, etc.* Fourth edition, revised and enlarged. William Wood & Co., New York, 1925.

Although this synopsis is only what it claims to be and is in no sense a text book, it requires, with index, 1,000 pages to present the facts contained in the briefest possible manner. It is the most complete synopsis that has come to the reviewer's notice and it is difficult to conceive of a book better suited to its purpose, the rapid review of the essential details of medicine, particularly for one who is preparing for examination and has only a limited time at one's disposal. That this is the fourth edition published since 1920 attests its popularity in England.

RECENT ADVANCES IN PHYSIOLOGY, by *C. Lovatt Evans, D. Sc. (Lond.), M. R. C. S., L. R. C. P., F. R. S., Fellow of University College, London; Professor of Physiology at St. Bartholeomew's Medical College, University of London.* P. Blakiston's Son & Co., Philadelphia, 1926.

A small book of 364 pages with 69 excellent illustrations. The first five chapters deal with the blood. The following chapters take up the recent advances in psysiology on the output and work of the heart, capillary circulation, tissue oxidations, muscular contraction, active principles of some of the endocrine glands, postural and conditioned reflexes.

The book presents to the student who has worked through an ordinary textbook, an account of some of the problems with which physiologists have been concerned during recent years and thus serves not only to enrich his knowledge of subjects of contemporary interest, but also to form a convenient bridge by which he may pass into the original literature of those subjects.

MOUTH, THROAT, NOSE, EAR, AND EYE, by *Thomas H. Odeneal, M. D., Otologist, Rhinologist, Laryngologist, and Opthalmologist to the Beverly Hospital Corporation, Beverly, Massachusetts; Massachusetts State Infirmary; etc.* P. Blakiston's Son & Co., Philadelphia, 1926.

To cover thoroughly all the conditions dealt with would be obviously impossible in a book the size of this one. Therefore, the author has wisely confined himself largely to the nonsurgical treatment of the many ailments to which these parts are subject. The book is a practical one, based largely upon the author's own experiences, and will be useful to the general practitioner rather than to the specialist.

MEMORANDA OF TOXICOLOGY, by *Max Trumper, B. S., A. M., formerly Lecturer on Toxicology, Jefferson Medical College.* P. Blakiston's Son & Co., Philadelphia, 1925.

A very useful little book for the doctor who is called upon to treat cases of poisoning. While small enough to be slipped into

the pocket, it contains the essential facts concerning the symptoms and treatment of most of the forms of poisoning with which one is likely to come into contact. Tetraethyl lead is dealt with and considerable space is given to the subject of poisoning by alcohol, both eythl and methyl.

HEADACHE, by *Dr. Thomas F. Reilly, sometime Professor of Medicine, Fordham University; Attending Physician, Bellevue and Allied Hospitals, etc.* P. Blakiston's Son & Co., Philadelphia, 1926.

Headache is such a prominent and common symptom of many disease conditions that the importance of recognizing its character and cause is apparent. The author has, in this book, discussed all types of headache commonly met with and has stated his ideas as to causation. Headaches are classified by him into (1) toxic, (2) mechanical, and (3) reflex. In arriving at a diagnosis one must consider, according to the author, the kind of pain, the time of day at which it occurs, and the portions of the head affected. Treatment resolves itself, in most cases, to relief of symptoms and for this, in almost all cases, the author recommends the use of the old stand-bys, coal-tar products. The importance of surgical intervention in headaches of mechanical origin is pointed out.

INTERNATIONAL CLINICS, Edited by *Henry W. Cattell, A. M., M. D., Philadelphia.* Volume I. Thirty-sixth series, 1926. The J. B. Lippincott Co., Philadelphia, 1926.

This volume shows the same careful selection and editing of papers that characterize all of Doctor Cattell's work. The subjects of the papers are so diverse as to cover a large part of the fields of medicine and surgery.

Among the most interesting and important articles contained in this volume are: "The diagnosis and treatment of cardiac arhythmias," by Edward C. Reifenstein of Syracuse University; "The treatment of metasyphilitic disorders," by Plaut of Munich; and "The motions of the larger joints," by Ashhurst of Philadelphia.

The section devoted to the progress of medicine for 1925 is admirable.

THE DIVISION OF PREVENTIVE MEDICINE

Lieut. Commander J. R. PHELPS, Medical Corps, United States Navy, in charge

Notes on Preventive Medicine for Medical Officers, United States Navy

THE NAVY RATION FROM THE VIEWPOINTS OF NUTRITIONAL SCIENCE AND PRACTICAL ADMINISTRATION—Continued

PART II

By J. R. PHELPS, Lieutenant Commander, Medical Corps, United States Navy

ESSENTIALS OF A WELL-BALANCED DIET

It is not practicable to write a short definition for the term "well-balanced diet." Clearly, too many considerations are involved to make a shore definition worth while. But, contrariwise, it may be said, a diet can not be regarded as well balanced unless it is consistent with health and vigor, long life, full procreative power, and the endowment of descendants with protoplasm of good biological quality.

In spite of the vast amount of research work performed during the past few years only a beginning has been made toward complete understanding of physiological chemistry. Studies in the great field of biological chemistry can be expected to reveal more of nature's secrets than have yet been brought to light. At the present time, therefore, it is more practical to point out certain known defects which will lead to dietary deficiences or cause the diet to be unbalanced than to attempt to describe a diet that can be guaranteed to be properly balanced.

We may, however, generalize to a helpful degree and say that the essential features of a well-balanced diet are:

1. Adequate but not excessive fuel value, with suitable proportionate amounts of proteins on the one hand and of fats and carbohydrates on the other.
2. The proteins ingested must furnish all required amino acids in at least optimum quantities.
3. All known vitamins must be included in quantities certain to fulfill all physiological requirements. This means, practically, that liberal use must be made of the protective foods—milk, butter, eggs,

leafy vegetables, and fruits—although whole seeds and certain organs of animals may be depended upon in part as sources of supply.

4. Irrespective of the fuel value of the diet, sufficient quantities of foods selected from the animal or vegetable kingdom or from both must be fed regularly all together to insure equilibrium of essential mineral constituents and normal utilization of these elements—calcium, phosphorus, sulphur, sodium, potassium, magnesium, chlorine, iron, iodine, fluorine, and silicon.

5. Meals as prepared for consumption daily must include sufficient proportionate amounts of vegetables and fruits which yield basic ash to neutralize acid-forming foods such as meats, white bread, etc. Fortunately vegetables and fruits, which are valuable sources of vitamines or minerals, serve this purpose, and it is also important that liberal amounts be included in the diet because of the vegetable fiber they contain.

6. Sufficient amounts of foods which contain vegetable fiber (cellulose) in palatable form must regularly be fed to provide roughage for stimulation of intestinal peristalsis and to form feces of proper bulk.

7. Enough water must be contained in the food as prepared and drunk in the form of beverages along with the food, as well as water taken between meals, to promote regular, once or twice daily, evacuation of the bowels.

8. Desirable extractives and flavorings must be included in proper proportionate amounts to make the food palatable and to stimulate secretion of the active principles concerned in the digestion and assimilation of nutrients.

A diet that appears well balanced on paper manifestly may fail to satisfy if the articles which should be cooked are badly cooked. Other things being equal, it is desirable that foods which can be eaten safely and to good nutritional advantage without cooking be served raw. The manner in which food is served also has considerable bearing on palatability and not infrequently upon the amount that will be eaten—or wasted as the case may be.

DIET WITH RESPECT TO THERMAL AND DYNAMIC CONSIDERATIONS

Nutrients.—Nutrients are proteins, fats, and carbohydrates. All are combustible and all may be oxidized within the body with the release of energy for the production of heat or mechanical work. Proteins alone furnish building material for the growth and repair of tissues. Proteins, fats, and carbohydrates are interchangeable within the body as sources of heat and energy in the form of muscular work.

The quantity of oxygen consumed is, of course, the measure of the sum total of metabolic changes. Metabolism regulates respiration. As Lusk puts it, *the absorption of oxygen does not cause metabolism, but rather the amount of the metabolism determines the amount of oxygen to be absorbed.* Breathing, even in an atmosphere of pure oxygen, does not increase the rate of metabolism.

Pettenkofer and Voit discovered that the fasting organism supports itself by the combustion of its own protein and fat. Voit showed that muscle work did not increase protein metabolism and that the rate of metabolism was not proportional to the oxygen supply.

Voit also found that dogs could maintain themselves on an exclusive protein diet and that when fat was added to such a diet the fat was almost entirely deposited in the body but that carbohydrates, if added, were burned no matter how much was fed. His conclusion was, of the three, protein, which burns with difficulty outside the body, metabolizes most readily, then carbohydrate, and last, fat, although fats burn most readily in air. It remained for Rubner to complete experiments from which resulted the isodynamic law, "*Foodstuffs may under given conditions replace each other in accordance with their heat-producing value.*" Rubner stated the following to be *isodynamic*: 100 grams of fat, 232 grams of starch, 234 grams of cane sugar, 243 grams of dried meat.

A long line of experimenters, from Voit to Lusk and others of our day, have shown that the performance of muscular work does not require an increase in the intake of protein above the amount necessary to meet other needs of the organism, provided carbohydrate or fat or any combination of these is ingested to furnish the necessary number of heat units for work and heat. However, it does not follow that an excess of protein if eaten will not also furnish energy, perhaps more efficiently than carbohydrates or fats. It has been shown that animals can be maintained and worked with carbohydrate as the principal source of energy, on a diet that contains no fat.

Rubner discovered that the output of heat in the resting state is proportional to the area of the surface of the body and later he showed that if the diet is increased from a medium to an abundant amount the rate of metabolism increases as evidenced by increased heat production. The ingestion of food in itself thus gives rise to dynamic action. Rubner found that this dynamic effect was greatest when protein was consumed.

Work, heat, and electricity result from the oxidation of nutrients, all of which can be expressed in terms of heat units. When, through practice or training, a certain kind of muscular work is performed, with comparatively little appreciated effort, considering the end

attained, the individual's muscles are working efficiently as a heat engine. Less heat is generated through concussion, friction, and slipping movements or wasted effort, so a correspondingly greater proportion of the calories involved are work calories and a smaller proportion heat that tends to raise body temperature than is the case when an equal amount of work is inefficiently performed.

The body is a heat engine, but in addition it is a chemical laboratory the products of which are used for the digestion of foods and assimilation of nutrients and minerals, for the growth and repair of tissues, for the maintenance of body temperature normal for the species, and for protecting the organism against harmful substances, organic and inorganic, dead matter and living microorganisms.

As heat engines human bodies will obviously vary greatly in efficiency according to the work that is being attempted and according to the state of physical fitness. Apart from the performance of purposeful work, it is clear enough that mental reactions or reflexes, intellectual as well as emotional, also involve changes in the rate of metabolism. Any change in the rate of metabolism of course represents increased or decreased oxidation of protein, fat, or carbohydrate.

The word "metabolism," when not further qualified, means, broadly, the sum of chemical changes undergone by tissue substance and nutrients within the body. There are of course attending physical reactions. The term "anabolism" stands for the building up of tissue substance, gland secretion, etc., from molecules of simpler compounds derived from nutrients. "Katabolism" represents the breaking down into excretable form of protein, fat, and carbohydrate molecules, whether derived from the food ingested, from body tissue, or from body fluids. If, in a given period, all material anabolized is equal in weight to all material katabolized, the individual neither gains nor loses in weight. It is also proper to speak of the metabolism of mineral elements even though little or no transfer of heat units be involved in the chemical reactions undergone.

The terms "protein metabolism," "fat metabolism," etc., are self-explanatory. The terms "nitrogenous equilibrium," "nitrogen balance," and "nitrogen storage" require explanation. Of the nutrients, only proteins contain nitrogen, so nitrogen eliminated from the body in the excretions can be made a measure for determining protein metabolism. Nitrogen is not eliminated by the lungs, and the small amount contained in the sweat, epidermal scales, cut or falling hair, seminal fluid, etc., is for practical purposes negligible, at least in conducting experimental studies.

The nitrogen of the urine and feces is therefore taken as the basis for calculating protein metabolism. While the total amount of protein destroyed in the body may thus be regarded as accounted for by the nitrogen excreted in the urine and feces, it is apparent that unless no protein was ingested it is impossible in this manner alone to estimate how much of the protein metabolized was food protein and how much was body protein. Moreover, while it has been demonstrated that almost all of the total protein ingested is usually absorbed from the intestines, under various conditions, including putrefactive changes brought about by the action of bacteria, some of the nitrogen recovered in the feces may have been derived from proteins whose amino acids did not leave the intestinal tract. Again, the determination of excreted nitrogen does not alone indicate the relative extent to which the protein metabolized was used as building material in the construction and reconstruction of body tissues or how much entered into the formation of compounds that were burned as fuel. But, apart from such detailed considerations, if the total amount of protein ingested was greater than that represented by the total of nitrogen excreted, it may be assumed that storage of nitrogen has occurred incidental to the growth or repair of tissues. Conversely, if the nitrogen excreted exceeded the intake, body proteins must have been consumed. Lusk quotes Voit's statement that when protein alone is ingested by a normal adult it is very readily oxidized and is only with the greatest difficulty deposited so as to form new tissue in the organism and thus increase body weight.

Nitrogenous Equilibrium

A body is said to be in a state of nitrogenous equilibrium when the amount of protein ingested is equal to the amount destroyed in the body, or more accurately stated, when the nitrogen intake is just balanced by the amount of nitrogen excreted. Voit showed that if that quantity of protein be administered which corresponds to what is being oxidized in the fasting state, nitrogenous equilibrium will not be established but some of the body's flesh will also be metabolized. The destruction of body protein grows steadily less as the protein intake is gradually increased until the amount of protein ingested is equal to that destroyed in the body. The body is then in a state of nitrogenous equilibrium *on the lowest possible intake of nitrogen* that can be fed to maintain the balance without feeding protein sparers; *i. e.*, carbohydrates and fats. As Lusk points out, but not exactly in this connection, "one may thus have nitrogen equilibrium without having carbon equilibrium." Lusk also writes: "If the quantity of meat ingested be steadily increased after nitrogenous equilibrium has been reached, the protein metabolism will gradually

increase, nitrogenous equilibrium will be established at higher and higher levels, and there will be a corresponding diminution in the amount of fat burned." Conversely, therefore, protein may serve as a fat sparer. Gelatin, which is an incomplete protein, serves within rather narrow limits as a sparer of body proteins. Lusk states that the ingestion of 7.5 per cent of the total heat requirement of the body in the form of gelatin spares 23 per cent of the body protein that would otherwise be lost, whereas 60 per cent of the requirement prevents only 35 per cent of the protein waste. Therefore, a small quantity of gelatin has almost as great an effect as a large quantity when fed as the sole source of amino acids. Of the essential amino acids, gelatin lacks tyrosene and tryptophane. Nitrogenous equilibrium can not be attained with a protein that does not contain tryptophane, or, presumably, with a protein in which any of the amino acids that cannot be synthetized in the body is missing.

The estimations of the protein-sparing effect of gelatin quoted above relate to gelatin when ingested alone; that is when no complete protein is fed. Murlin has shown that the sparing power of gelatin is greater when it is taken with a mixed diet containing proteins. He also showed that the sparing effect depends directly upon its content of amino acids and not upon the fact that 60 per cent of gelatin by weight can be transformed into glucose in metabolism.

Like gelatin, other incomplete proteins which contain most but not all the amino acids which are indispensible but which the organism can not synthetize, have the power to reduce the amount of body proteins destroyed when no proteins are ingested, and still greater sparing effect when fed with proteins in a mixed diet. Isolated amino acids derived from protein as well as certain amino acids that can be synthetized in the laboratory may likewise spare body protein. Indeed, ammonium citrate and ammonium acetate have also been found to conserve body protein when fed with fats, carbohydrates, and essential minerals.. One or more of the necessary amino acids may be synthetized from these salts within the body.

From the hygienic viewpoint, as Gatewood wrote, a true nitrogenous equilibrium can not be considered as existing unless the balance is maintained with the *smallest* nitrogen intake that will suffice. The desirability of maintaining nitrogenous equilibrium at such a low level is a question that had best be discussed elsewhere rather than at this point.

Nitrogen Storage (Retention of Protein)

Apart from the utilization of amino acids for the construction of proteins as building material for the growth of body cells, it appears that only a very small storage of nitrogen is possible in the form of

"deposit protein." Lusk refers to a paper by Lüthje as indicating that this is not stored in the blood but is probably retained in the cellular fluids, just as glycogen is retained by the cells. The point has not been settled; it is possible that "deposit protein" is "cell protein." It is also possible that the storage is largely in the liver. It remains to be settled whether sulphur is stored in corresponding ratio to the storage of nitrogen during the period of change from low to high protein metabolism. Phosphorus metabolism may follow a different rate of storage under all conditions because that element enters not only into the metabolism of nucleoproteins but is concerned also in the deposit of calcium in the bones and teeth and the formation of phosphates elsewhere.

Lusk points out that retention of protein depends upon the protein content of the animal as well as upon the quantity of protein ingested. If there has been depletion through fasting or disease a small intake of protein may permit as much retention of nitrogen as a large intake would in a healthy and well-fed individual. Lusk concludes that adult cells which have been depleted of their protein may gradually improve their nutritive condition until they reach an optimum, at which point they lose their power to attach additional protein. If that is the case, from the hygienic standpoint it would seem desirable for an individual at least to ingest sufficient protein constantly to keep a plus nitrogen balance and enable the tissues to maintain this optimum or maximum storage, representing repair and building material at hand.

Carbohydrates and Fats as Sparers of Protein

If the diet includes carbohydrate, nitrogenous equilibrium will be established at a much lower level than when protein alone or a mixture of fat and protein is fed, and equilibrium may be maintained actually with less ingested protein than the amount of body protein that would be katabolized in starvation. It has been found in the case of a healthy man weighing 132 pounds that nitrogenous equilibrium could be maintained with a diet rich in carbohydrates on as small an intake of protein as 39 grams per day.

With decreasing intake of protein the protein-sparing effect of carbohydrates becomes of relatively greater importance. Fat of course can be extensively stored in the body where it is available as fuel when called for. The body fat is not entirely consumed in experimental periods of fasting, at least not in human subjects, and dogs can maintain themselves on an exclusive protein diet, storing fat if fat is added to the diet. The ingestion of fat alone by a human subject at the end of a period of starvation will not reduce the amount of body protein katabolized and there is thus declared an apparent

failure of ingested fat to act as a protein sparer. However, it has been found under similar conditions that when the food consists partly of carbohydrates and partly of fat the protein saving power of the diet is as great as that of a diet of equal fuel value composed of carbohydrates alone. Fat therefore acts directly or indirectly as a protein sparer but, inasmuch as the diet must contain carbohydrate, or body fat can not serve to the same degree to spare body protein, carbohydrate may be regarded as the great sparer of protein, the effect of gelatin and other incomplete proteins which are lacking in certain of the essential amino acids not being taken into consideration in this connection.

Lusk states that the higher protein-sparing property of carbohydrate gives dogs exclusively fed on carbohydrate a longer lease of life than is granted dogs fed on fat alone, but the end result is of course the same in both cases. When carbohydrate alone is fed at the end of a starvation period, the destruction of body protein is at once reduced; in some cases to one-third the fasting value.

It is apparent that the ingestion of carbohydrate has a profound influence on protein metabolism and that partial replacement of carbohydrate by fat may not affect the amount of protein metabolized. There is a limit to the extent to which fat may replace carbohydrate without inducing acidosis, and this probably varies in different individuals and also between extremes of climatic conditions. Zeller found in one experiment with a man ingesting a total of 3,300 calories, protein calories representing about 5 per cent of the total, fat 85 per cent, and carbohydrate 10 per cent, so that for each molecule of a monosaccharid in the diet there were two molecules of fat, he began to excrete acetone in the urine. As might be expected, when the whole diet consisted of fat calories the excretion of acetone increased, there was increasing production of ammonia to neutralize acid formed, and the subject felt weak and uncomfortable. Withdrawal of carbohydrate from a mixed diet and substitution therefor of either fat or protein results in reduction of body weight associated with loss of water and loss of glycogen.

Specific Dynamic Effects of Nutrients

The rate of total metabolism, which represents the rate of oxidation of protein plus fat plus carbohydrate during a specified period, depends upon a combination of factors. Percepts, ideas, and emotional reactions which lead to motor reflexes and consequent responses in the form of muscular contractions set the organism as a heat engine to work. These responses, whether constituting involuntary reflex movements of smooth or striated muscles or purposeful

contractions of skeletal muscles, all require the burning of fuel, the utilization of just so many calories, the expenditure of just so much energy measured in terms of heat units. Some of the energy is expended in the form of mechanical work, which if it could be accurately accounted for and measured could be expressed as so many units of work, foot-pounds or kilogrammetres. In the science of physics two kinds of work are recognized—work of acceleration and work against resistance. In either case, if work results from the application of force, the mass acted upon must move while the force continues to act.

Oxidation of nutrient material in a muscle causes molecular changes, making contractions and performance of work possible. All other oxidations in the body produce heat directly. When the body is at rest all functions are transformed into heat. Heat is constantly being liberated directly in all parts of the body by oxidation, but a great deal more heat is being released when skeletal muscles are noticeably contracting. Although some of the energy of the oxidizable substances is transformed into work by the contracting muscles, a great part of the total energy involved in muscular work is changed into heat by friction locally; that is, by friction of the muscles and tendons in their sheaths and by friction in the joints where movement of bone takes place. Additional transformation of energy into heat occurs by friction or through concussion when parts of the body slide or strike against the footing or other external objects.

A great deal more heat is of course being liberated and distributed throughout the body by the circulation of blood when muscular work is being performed than when the body is at rest, but heat production is continuous even with the muscles relaxed and the subject at rest, as while lying in bed warmly covered, so that special regulation of body temperature by chemical means will not be required. Temperature regulation will be discussed later. Here it is only necessary to state that when the production of heat incidental to the voluntary use of muscles or to the digestion and absorption of nutrients is insufficient to keep the temperature up to normal, a sensation of chilliness is felt as a part of reflex action that leads, through shivering or other involuntary muscular contractions, to the oxidation of the requisite amount of fuel to raise the temperature.

The point under consideration here is that power is required and energy is used by the body in the performance of its work as a chemical laboratory, for the work of digesting, absorbing, and utilizing, or eliminating the food eaten. The heat produced purely as a consequence of the chemical changes involved in these processes depends upon the nutrient metabolized and also upon the quantity ingested. The heat so liberated is said to represent the *specific*

dynamic power of the food in question. The specific dynamic power of proteins is much greater than that of fats or carbohydrates. Proteins, fats, and carbohydrates have each their specific dynamic power, but the least power is said to be exerted by carbohydrates. As a matter of fact the metabolism of fat depends upon so many variable conditions that under some circumstances fat eaten may involve less liberation of heat than carbohydrate.

Specific dynamic power of protein.—Experiments have shown that protein can be stored in the body as protein or in the form of compounds of its constituent amino acids only to a very limited extent above the quantity required for growth and wear and tear replacement in tissues, especially when the daily intake is greater than required for the maintenance of nitrogenous equilibrium on the smallest amount that will establish nitrogen balance. There is evidence that proteins may and do split in some phases of metabolism into nitrogenous fractions and nonnitrogenous fractions, and that glycogen and glucose are formed from the latter. Since fatty acids and neutral fat may be evolved from glucose, fat may thus indirectly be formed from the carbon and hydrogen ingested as protein. It is therefore unnecessary from this particular viewpoint to consider whether protein fractions can be directly transformed into fat. Some of the protein mass can ultimately be stored in the body in the form of fat and likewise as glycogen up to the limit of glycogen storage. In view of the very limited capacity of the organism to store nitrogen, protein ingested in excess of current needs and above storage capacity must be destroyed and converted into nitrogenous compounds that can be eliminated by the kidneys or intestines, and remaining fractions of the heavy protein molecule must be oxidized (burned) or transformed and stored as glucose or fat. An excess of protein may be utilized at once as fuel for the performance of muscular work. If work is not being done, the heat liberated by oxidation is eliminated by the skin and the individual is not aware of its production unless the weather is so hot that the body tends to become overheated.

The necessity of getting rid of an excess of protein, resulting from limited capacity for storage of nitrogen, involves chemical changes that partly account for the greater heating of the body after the ingestion of proteins, but, in any case, more chemical work, expressed in terms of heat units, is required to break down the heavy and complex protein molecule into constituents suitable for tissue use than is required for the utilization of the fat or carbohydrate molecule.

The specific production of heat is that which results purely from ingesting the protein. The amount of heat so produced will be liberated whether or not the body has need of it for the regulation of its temperature.

Rubner discovered this phenomenon which he termed the *specific dynamic action* of protein. The action is well brought out by feeding protein to a starving animal. It might be supposed that if the animal which is losing a certain amount of tissue protein daily is given just that amount of protein as food, nitrogenous equilibrium would be established and tissue needs satisfied, but as already mentioned that is not the case. Upon increasing the intake of nitrogen the output increases and the balance remains negative. Nitrogenous equilibrium is not attained until the daily output is about three and a half times as great as it was while the animal was receiving no food. Increasing the amount of protein in the diet leads to an increase in the total metabolism.

More food is thus oxidized and more heat is produced on a diet rich in proteins than upon a diet which contains less protein. In the case of the human subject the carbon balance may remain negative even when nitrogenous equilibrium is established because the metabolism of fats and carbohydrates is stimulated by ingesting protein. Although the utilizable fuel value of a gram of protein is ordinarily taken to be 4 calories and that of a gram of carbohydrate likewise 4 calories, protein can not replace carbohydrate in the diet gram for gram and continue to replace tissue loss to the extent that is possible with a like amount when carbohydrate is fed with the protein. That is due to the protein-sparing action of carbohydrate discussed above. Proteins, as brought out above, can not replace either fats or carbohydrates in isodynamic quantities. It is describing the same situation to say that this is due to the specific power of the protein to increase the metabolism of fats and of carbohydrates. It therefore appears that some of the heat produced as a result of ingesting protein comes from the oxidation of fats and carbohydrates and some from the oxidation of the protein.

Rubner attempted to measure the specific production of heat arising from the ingestion of nutrients. He determined the basal metabolic requirement of a fasting dog kept in a room heated to 33° C. (91.4° F.). The increased metabolism caused by different foods was noted. It appeared that the full requirement for energy in the form of fat raised the metabolism 12.7 per cent; in the form of sugar, 5.8 per cent; and in the form of protein, 30.9 per cent. That is, for every 100 calories in the protein fed, additional production of heat amounted to 30.9 calories. Lusk mentions the dog used by Williams, Riche, and himself. The animal under suitable experimental conditions showed an increase of 30 calories in heat production for every 100 calories contained in the protein of 1,200 grams of meat ingested. The results of eating mixed foods are not so

pronounced as when a single nutrient is fed to a fasting animal or to a fasting man. Lusk quotes Rubner's estimate that average mixed diets must contain between 11 and 14 per cent more calories than would be required to maintain a subject in caloric equilibrium if it were not for the calories used in this specific manner for the absorption and utilization of the nutrients regardless of additional heat and work requirements.

Recent studies indicate that proteins vary considerably in specific heating power according to the proportionate amounts of the different amino acids contained in the protein molecule. Individual amino acids as obtained by hydrolysis of proteins in the laboratory when fed separately have been found to possess this specific dynamic power, but in different degrees, some of them greatly increasing the production of heat when administered and others but little. From a practical standpoint a considerable production of heat is usually an immediate result of the ingestion of a material amount of protein, and this is purely the result of ingesting the protein. In other words, if protein alone or mixed with other nutrients is fed to a resting individual a marked increase occurs in the rate of metabolism, as measured by the quantity of oxygen consumed in the body. If protein alone is fed, the increase measures the specific dynamic action of the protein, under the conditions surrounding the observation. To repeat, this specific heating power is possessed to a much greater degree by proteins than by the other nutrients, although the digestion and assimilation of fat or carbohydrate does also specifically involve heat production apart from the heat produced by utilization of the nutrient for energy in performing muscular work or in keeping the body warm.

Specific dynamic power of carbohydrate.—As ordinarily ingested, the specific heating effect of carbohydrate is linked with the action of amino acids, derived either from body protein or ingested protein, in stimulating increased production of heat, but, finally, the rate of combustion and the amount of blood sugar consumed depend upon a number of factors including the quantity of insulin secreted by the pancreas, existing capacity to add to the storage of glycogen, and existing capacity of the organism to convert carbohydrate into fat and store the fat so formed without combustion. If the concentration of glucose in the blood exceeds a certain limit glucose will be filtered through the kidney and thus be excreted unchanged. Such elimination seldom takes place in healthy individuals unless a large quantity of sugar is ingested at one time.

To look back over the literature, Benedict stated in 1912 that the cause of the specific dynamic action of carbohydrates is the formation of acids which act as stimuli. Carbohydrates vary among them-

selves with respect to the intensity of this specific action, gram for gram, owing to differences in the rapidity of conversion and absorption, immediate combustion, or storage in the form of glycogen. Very soluble sugar is entirely absorbed in a few hours. Sugar is evenly utilized by the tissues, ordinarily, as it enters the blood stream, although an excess up to the point of tolerance of the individual may be stored as glycogen until needed by tissue cells. If the stored supply has become depleted, the ingestion of glucose may not be followed by an increase in the rate of metabolism, as calorimetrically measured, because of conversion into glycogen, but, otherwise, increased metabolism occurs which does not depend directly upon the amount of glucose ingested, because of self-regulatory control on the part of the organism, involving the secretion of insulin. An increase in the elimination of carbon dioxide occurs shortly after the ingestion of glucose. This is indicative of rapid absorption and prompt combustion. In dogs a rise in the percentage of blood sugar has been found to occur in one hour after feeding 50 grams of glucose, followed by a gradual fall to the normal percentage. A sudden increase in the quantity of urine excreted occurs about the time the last of the feeding of glucose is absorbed from the intestine, and the increased rate of elimination is also coincident with the period of increased metabolism resulting from the ingestion of the sugar. The glucose, as it is absorbed, appears to pass on into the general circulation, the liver retaining very little.

Lusk stated, before the discovery of insulin, that the real cause of increased heat production after the ingestion of carbohydrate seems to be a plethora of acetaldehyde molecules which the tissue cells are capable of utilizing within the limits of self-regulatory processes.[1] It seems obvious, he wrote, that glucose when given in large amounts scarcely affects metabolism, but that the chemical stimulus of amino acids acting in conjunction with a plentiful supply of glucose results in a rise in heat production which is nearly the sum of the two individual influences acting separately. When alcohol is given with glucose the rate of metabolism rises above the level it would have attained had glucose been ingested alone. Experiments by Lusk and Murlin have shown that if glucose be ingested at the time of greatest fat metabolism there is additional heat production to the same extent that the glucose alone would have increased the rate of metabolism. When glucose and the amino acid, glycocoll, are given together so that their molecules enter the circulation at the height of fat absorption, the increase in metabolism is very nearly equal to the sum of the increases which each of the three materials would have induced alone. Heat production is somewhat greater following the ingestion of fructose than

when glucose is eaten, due either to greater effect upon fat combustion or additional chemical changes required for the conversion of fructose into glucose.

Outline of chemical changes undergone by carbohydrates in metabolism.—Carbohydrates comprise the starches and sugars. From the chemical standpoint, protein metabolism and starch metabolism are very similar. In the digestive process, hydrolysis occurs; after that, there is partial combustion of the end products, and portions of the end products may be synthetized into substances chemically like the originals but peculiar to the animal organism and not the vegetable substances from which the originals may have come. In the case of proteins, after hydrolysis, glucose and also fatty acids can be produced from the constituents and, of course, tissue proteins can be synthetized from the amino acids.

Starch, upon hydrolysis, yields the polysaccharide dextrins, the disaccharide maltose and, finally, as the end product, the monosaccharide glucose.

Glucose.—The carbohydrates as they exist in foods and food stuffs in greater or lesser purity as derived from natural sources, are all convertible in the body into glucose (*dextrose*), otherwise known as grape sugar, starch sugar, or corn sugar. Glucose which may be produced readily by the hydrolysis of starch is now widely manufactured from corn. Some popular prejudice, resulting from ignorance of the chemistry of the carbohydrates and methods employed, exists against the manufactured sugars, and especially against glucose. Glucose, of course, is the physiological sugar. To the taste, however, it is not so sweet as the disaccharide cane sugar and not nearly so sweet as fructose (*levulose*), otherwise known as fruit sugar.

Fructose.—This is commonly known as fruit sugar. It has the same chemical formula as glucose, $C_{12}H_6O_6$, but differs in that it rotates the beam of polarized light to the left instead of to the right. Fructose occurs with more or less glucose in fruits, plant juices, and especially in honey, of which it constitutes about 50 per cent of the solid matter.

Cane sugar.—Upon hydrolysis, cane sugar yields equal quantities of glucose and fructose. If the sweetness of sucrose, otherwise known as saccharose or cane sugar, be rated as 100 (editorial, J. A. M. A., 86:9), glucose has a value of 74 and fructose of 173. Fructose enters the blood stream in health in very small amounts. When eaten as fruit sugar or ingested in cane sugar it is absorbed, but, upon reaching the liver, practically all of it is converted into glycogen. Glucose and fructose are in part convertible, either into the other, in the presence of dilute alkalies (Sherman).

Lactose, otherwise known as milk sugar, is a disaccharide which, upon hydrolysis, yields glucose and galactose. The latter is not found free in nature. When freed by the action of digestive ferments it has been thought to be as readily convertible into glycogen in the liver as glucose or fructose. In this connection, however, it is interesting to note that the tendency seems to be growing among physicians to substitute maltose for lactose in feeding young infants who appear to be having difficulty in metabolizing milk sugar when added to cow's milk.

Maltose, otherwise known as malt sugar, is a disaccharide that is formed from starch hydrolyzed by the action of digestive ferments, ptyalin, amylopsin, by diastase, and by boiling with dilute mineral acids. The molecule of maltose consists of two molecules of glucose which are freed when maltose is in turn hydrolyzed, which it readily is, by the action of a ferment secreted by intestinal mucous membrane, or by boiling with dilute mineral acids. While the duoble molecule of glucose, maltose, probably is not ordinarily absorbed as such, it is readily utilized by the tissues when administered intravenously; possibly more readily than suchrose or lactose. Glycogen yields maltose under the action of diastatic enzymes. It is likewise yielded by dextrin. Maltose is formed in germinating cereals. It is formed in certain fruits, that contain strach, as they ripen. It is a constituent of malt and malted products.

Dextrins, which have the same general chemical formula as the starches, $(C_6H_{10}O_5)x.H_2O$, are yielded by starch upon hydrolysis under the influence of enzymes, malt ferment, acids, or heat. Commercially, dextrin is manufactured from starch by heating it with or without very dilute acid. Dextrin is much more soluble than starch. The dextrin molecule while much heavier than the molecule of any of the sugars is smaller than the molecule of starch—one-fourth or less. The molecule of common starch is probably more than one hundred times as heavy as the molecule of glucose, and possibly three hundred times as heavy.

Starch $(C_6H_{10}O_5)x$, belongs in the general group of polysaccharides, all of which are colloids. Mixed with water and thinned down sufficiently, starch forms a colloidal dispersion that will pass through filter paper. Some starches when treated with water become gelatinous; others do not. Starch hydrolyzes into dextrin and maltose; as hydrolytic cleavage continues the dextrin is converted into maltose and glucose, and the maltose into glucose, so the only end product is glucose.

Glycogen has the same general formula as the starches of the vegetable kingdom $(C_6H_{10}O_5)x$. It is known as animal starch, al-

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though it is found as storage carbohydrate instead of vegetable starch in fungi and certain other low forms of plant life devoid of chlorophyll.

Glycogen is found in all tissues in the lower as well as the higher forms of animal life. Storage of glycogen in the liver is affected (increased or decreased) by rest and muscular work, by varying activity of the pancreas, and by variations in the amount of food ingested, especially carbohydrates.

Since glucose may be derived from constituents of protein, storage of glycogen may result from the metabolism of proteins as well as from the ingestion of carbohydrates, and some students of metabolism also add that glycogen may perhaps be derived from fats. It has been suggested by Maekowitz that liver glycogen is an essential step in the formation of sugar from fat or protein.

Glycogen is not merely stored carbohydrate. Studies in diabetes and, of late, study of the effect of insulin upon diabetic patients has led to a newer conception of the importance of glycogen, wherein it appears to be dynamic material which is constantly being used, and almost as quickly being replaced, when metabolic conditions permit.

It is not possible to exhaust the store of glycogen altogether by starvation. Glycogen may indeed accumulate during a period of starvation. A certain minimum percentage of glucose in the blood is indispensable; hypoglycemia below that point brings disaster. Utilization of glycogen, when glucose is not available as glucose, makes possible the maintenance of a safe blood sugar content. Joslin has remarked that carbohydrate metabolism from beginning to end depends upon insulin. The oxidation or utilization of glucose depends upon the presence of insulin, and insulin must also be available or glycogen synthesis is prevented and there is at least great interference with the storage of glycogen in the liver. Perhaps storage ceases altogether in the absence of insulin. The tendency now is to regard glycogen as an obligatory step in the transformation of blood sugar from the noncarbohydrate stores of the organism (editorial, J. A. M. A., 85:19). With knowledge of the part played by insulin in the oxidation of glucose it might be conjectured that the specific dynamic effect observed after the ingestion of glucose can be explained by assuming that the pancreas is stimulated directly or indirectly to increase the secretion of insulin.

The specific dynamic power of fat.—Fats, like the other nutrients, have this power, and the additional heat produced after eating fat appears to be derived from the fat itself. The results of feeding experiments to determine the specific increase in metabolism have been variable. The effect probably depends upon a number of conditions, including the state of nutrition with respect to the amount

of fat already stored within the body, the individual's ability to oxidize fat rather than deposit it, and clothing, and atmospheric conditions—temperature, relative humidity, and air movement—as affecting the need for oxidation of nutrients for the chemical regulation of body temperature.

Murlin and Lusk found in one experiment with a dog that the specific production of heat resulting from a feeding of fat amounted to 4.1 per cent of the energy in the fat. This represented greater specific dynamic action than would result from feeding sugar under similar conditions. After the ingestion of fat, heat production gradually increased up to the sixth hour, when the rate was found to be 30 per cent above the rate of basal metabolism. After the sixth hour the rate gradually fell, reaching the basal level 10 hours after feeding. In man a maximal increase in heat production of from 10 to 15 per cent above the rate of basal metabolism may, under ordinary conditions, be expected to result from the ingestion of 200 to 225 grams of fat during the sixth or seventh hour after ingestion, with a return to the individual's basal level two or three hours later. But, the ingestion of more fat in the diet than is needed for fuel does not have the same effect on the rate of metabolism as the ingestion of protein above physiological requirements. The protein can be stored only to a limited extent and the excess is gotten rid of by destruction, excretion of nitrogenous constituents, and oxidation of some of the remaining fractions, the process involving increased metabolism whenever protein is eaten in excess, assuming the individual is on a high plane of nutrition so that he already has a plus nitrogen balance. Fats, on the other hand, may be stored within the body in large amounts, and, like a ton of coal thrown into the cellar, stored fat yields no heat unless and until it is oxidized. Rubner fed a dog for many days on a diet rich in fat, with the total fuel value about 60 per cent greater than the starvation requirement. During the later days the animal was in nitrogenous equilibrium. The dog continued to deposit fat and there was no increase in metabolism attributable to the consumption of fat. Rubner concluded that the secondary dynamic action, as regards protein, observed by him does not result from the ingestion of fat.

A diet which includes proteins in excess is beyond question a "heating diet" and the effect may be bad in hot weather when the individual's peripheral circulation and sweat glands are fully taxed with the necessity of transferring body heat to hot and humid air. While fat has potentially a higher specific dynamic power than sugar, the most readily utilizable form of carbohydrate, the inges-

tion of the latter to excess, as compared with the body's need for fuel at the time, is even more likely than fat to lead to extra production of heat. The effect of carbohydrate metabolism upon fat metabolism has a great deal to do with total heat production. As Joslin has put it, *the fats are consumed in the fires lighted by the carbohydrates.* The practical indication in hot weather is to eat a diet balanced as at other times but to eat less food—less protein, less fat, less carbohydrate. If there is to be a disproportionate reduction, logically, further restriction should be made with respect to proteins.

REGULATION OF BODY TEMPERATURE AND INFLUENCE OF ATMOSPHERIC CONDITIONS

A warm-blooded animal maintains its normal temperature throughout a period of prolonged fasting; likewise, man. The metabolism of cold-blooded animals depends to a great extent upon external temperature. The rate of metabolism is very low in hibernating animals during the winter sleep and the body temperature may be lower than that of the environment in the early days of spring. The increase in metabolism upon and just prior to awakening involves the combustion principally of body fat but probably of stored carbohydrate as well.

Rubner discovered that among warm-blooded animals, including man, under similar conditions respecting muscular activity and temperature of the environment, the metabolism or total heat production is proportional to the superficial area of the body.

The rate at which heat is being given off by the body is constantly being regulated to maintain body temperature normal to the species. Some heat is given off in the expired air, and some in the urine and feces, but in the case of human beings the skin is the great heat eliminating organ and, according to Winslow, about 80 per cent of the heat produced in the body is given off from the skin. A man weighing 140 pounds is estimated to give off, at ordinary room temperature, from 350 to 400 British thermal units per hour when at rest; from 375 to 475 when doing light work; and from 500 to 700 when engaged in hard muscular work. The British thermal unit is the quantity of heat required to raise the temperature of a pound of water 1° Fahrenheit. The large calorie which is the unit used in describing the energy of foods, is the quantity of heat required to raise the temperature of 1 liter of water 1° Centigrade, or the temperature of 1 pound of water 4° Fahrenheit. Consequently four British thermal units equal one calorie.

If, at any moment, depending upon the amount and kind of clothing worn at the time in relation to air movement, temperature, and relative humidity, the temperature of the body tends to fall, reflexes

are set in motion and certain regulatory changes that are purely physical in nature occur in the skin.

The skin blanches or less blood circulates through the skin vessels, and at once the quantity of heat delivered to the skin for transfer to the environment is reduced. This adjustment of the peripheral circulation is effected with great nicety; small changes take place rapidly and constantly, and different areas of the skin respond to varying local influences. The skin may be cool and dry at one point and adjusted for rapid elimination of heat elsewhere. Although the body as a whole may be conserving heat, one hand in a pocket or some other part warmly covered may be sweating. The skin gives off heat by (*a*) radiation, (*b*) conduction (air convection), and (*c*) by discharging sweat which evaporates when physical conditions of the air permit.

Radiation is an effective means of transferring heat when the body is naked. Pryor states that radiation is reduced 27 per cent at ordinary room temperature by wearing a wool shirt; 40 per cent with a linen shirt and wool shirt; and 66 per cent with underwear, linen shirt, trousers, coat, and vest.

Conduction of heat to the air proceeds at a rate depending upon the temperature of the air and movement of the air. The transfer of heat is promoted also by the convection currents set up in the air as its molecules become heated. For parts of the body touching other surfaces, floor, wall, furniture, etc., the rate of conduction for the skin area in contact is affected by specific heat or the greater or less capacity of the substance to absorb heat as compared with air, its temperature being the same as that of the air. A tile floor, for example, feels colder than a rug. The rate of transfer is also affected by the heat conducting power of the substance; as for example a metal which is a good conductor of heat.

When the transfer of heat from the body by means of radiation and conduction fails to check mounting temperature of the blood and tissues, the sweat glands in varying areas of the skin are stimulated and evaporation of water is called into action. The capacity of water to absorb heat in changing from the liquid to the gaseous form and to hold it in the form of latent heat until condensation occurs, obviously makes possible the rapid removal of great quantities of heat from the peripheral circulation when atmospheric conditions and the clothing worn promote free evaporation. Under all circumstances the rate of evaporation depends upon the physical properties of the air actually in contact with the skin and upon the freedom with which that air can rise, leave the body, and be replaced by fresh air. Beneath and between layers of clothing, summer and winter, ordinarily, there is a layer of more or less still, hot, and humid air in contact with the skin. Comfort, a very desirable

end result in the practice of hygiene, requires the application of common sense to the three closely related subjects—ventilation, nutrition, and clothing.

When the body is handicapped in transferring excess heat to air that is already warm and humid (or to very hot air even though the relative humidity be low) by lack of air movement in the environment or by clothing that interferes with convection and evaporation, the temperature of the body begins to rise. The effect of this is variable. The immediate effect is to increase the rate of metabolism.

According to Lusk, experiments convinced Rubner that an environmental temperature of 33° C. (91.4° F.) may be regarded as the *critical temperature* at which, other things being equal, metabolism is at a minimum. At temperatures below that level more or less chemical regulation of body temperature is or may be required, depending upon clothing, muscular work, and specific dynamic action of food ingested. Uusually when the temperature of the air rises above 86° F. sweating occurs, but there is no increase in metabolism as a result of the increased temperature, physical regulation by means of the evaporation of sweat sufficing to prevent a rise in body temperature. If the temperature of the air be high enough, or more exactly if the combined effect of air temperature, air movement, and relative humidity be such that the evaporation of sweat is limited to such a degree that the body temperature rises above normal, the rate of metabolism increases purely as the effect of increased temperature of the tissues.

Lusk states that the minimum requirement for energy is seen to be present when the fasting (and resting) subject is surrounded by an atmosphere having a temperature of 30 to 35° C. (86 to 95° F.). This may be regarded as the *basal metabolism* or the minimum of energy compatible with cell life.

Human muscles perform work more efficiently at a temperature above the normal or resting temperature. As with other heat engines there is a most effective temperature for the human machine. The combustion of fuel goes on at a faster rate as a result of the increased warmth; more work can be performed; and many kinds of work, running, base ball pitching, etc., can be performed more efficiently and more powerfully after the player or worker has warmed up, perhaps with the aid of a heavy sweater to reduce heat transfer during the warming up exercises.

There is, of course, a limit to the extent to which metabolism by warming up the tissues may be increased without inducing undesirable consequences. The human machine like an engine or an elec tric motor can become overheated with disastrous consequences. A great deal depends upon the characteristics of the individual and

whether or not he is well trained for the kind of work to be performed. Ability to sweat promptly and freely when the temperature rises above optimum is essential to prevent overheating unless the air is cool enough or moving sufficiently to take up heat so rapidly that sweating is not necessary for ridding the body of surplus heat.

A fat man with a thick layer of poorly conducting adipose tissue is more likely to have his rate of metabolism increased by exposure to high temperature than a thin man. If the fat man doesn't suffer discomfort thereby no harm is done. Nitrogen elimination is not likely to be affected. The increase is largely or entirely at the expense of fat. Lusk states that on a hot humid day the metabolism of a fat individual may be 50 per cent higher than on a day of moderate temperature and the same humidity .

When the weather conditions are very trying the thin individual has a better chance of remaining comfortable than a fat subject, theoretically, but the latter may possess superior sweating ability, and, practically, thin people often complain more bitterly of the heat than fat people. If the air conditions are such that sweat will not evaporate, the individual who is generating the greatest amount of heat in proportion to his needs will suffer the most. The ingestion of unnecessary food, especially of protein with its high specific heating effect, of course adds to the embarrassment of the organism when the skin is unable to eliminate heat rapidly enough to prevent the body temperature from rising.

Thermal Fever (Sunstroke)

As implied by the word "stroke" the subject may be overcome suddenly. However, the onset of symptoms may be gradual. Clinically the most characteristic manifestations are moderate to great increase in body temperature, and coma with labored or stertorous respiration, indicative of cerebral disturbance. Usually the skeletal muscles are completely relaxed, but there may be twitchings or even convulsions. The body temperature may rise to above 110° F. The face is flushed and the skin as a whole hot. Sweating is not a characteristic feature.

Whatever occurs within the body to bring on such a heat stroke, exposure to external heat is the exciting cause. The skin either fails to function or, because of the environmental physical conditions, is unable to transfer heat from within rapidly enough to prevent an increasing rise in body temperature. With rising temperature the rate of metabolism is increased and more heat is produced. Osler and other writers have pointed out that the ingestion of alcohol seems to predispose to sunstroke. It is not difficult to understand why that should be in view of the specific dynamic power of alcohol

even when ingested alone. The increased production of heat by the rapid oxidation of alcohol and glucose at the same time, resulting from the combined effects of the specific heating powers of the sugar and alcohol, increases the danger of thermal fever. Overeating of any kind of food may be a factor and in some cases, doubtless, the heat liberated as a result of eating a heavy meal a few hours before or shortly before exposure to intense heat may be the determining influence. The greatest heat production, of course, will result from eating a meal rich in proteins. Muscular work also involves the production of heat and this may be the final influence. Heat production from this source ceases when the individual rests, but he may not put his muscles at rest until it is too late to prevent sunstroke. The weight and character of the clothing worn is usually a factor. The skin is greatly hampered by the clothing in transferring heat by radiation and conduction and the evaporation of sweat is retarded. Dark clothing absorbs heat from the sun or other radiant source and the temperature of the clothing material and of the layer of air in contact with the skin may be higher than the temperature of the body, making the transfer of heat from within out practically impossible.

In most cases of thermal fever, especially in the typical sunstroke type of case, the victim has been exposed directly to radiant heat from the sun or from some other source. Clinically, the manifestations of thermal fever are quite different from those of heat exhaustion, but the exciting environmental conditions may be much the same, and, in fact, up to a certain point, the mechanism within the body is probably much the same in both forms of overheating. Initially the rate of metabolism is such that heat is produced in greater quantities than can be eliminated by the skin. In sunstroke cases the subject may have been sweating profusely in previous hours, but, at a certain point in the exposure, the skin fails to transfer heat rapidly enough to check the rising body temperature. Perspiration often ceases. The body and its clothing continue to receive much heat from the radiant source—sun, conflagration, furnace, hot metal surface, city pavements, heated walls of buildings, etc. The skin can not transfer heat from within out and reverse transfer may occur. The temperature of the tissues increases more and more rapidly. The conditions within the body are such that the production of heat can not lessen. If the production of heat is checked thermal fever does not develop. Continued generation of heat within the body is an essential feature of thermal fever; in heat exhaustion, at a certain point, the production of heat in the tissues ceases or is greatly reduced. As damage to the organism proceeds, acidosis develops because of an insufficient supply of bases to neutralize the acid ions rapidly freed with the increased rate of metabolism. In-

complete oxidation of fat to compounds other than the end products, carbon dioxide and water, due to exhaustion of glucose and glycogen, may then add the acetone and diacetic-Beta-oxybutyric acid type of acidosis to the picture.

Individuals probably vary a great deal as regards susceptibility to heat stroke and also to heat exhaustion. The efficiency of the skin as a heat eliminating organ varies not only according to the thickness of the layer of subcutaneous fat and the kind of clothing worn, but also according to the functioning of the nervous system behind it. The factors influencing the rate of metabolism also vary a great deal.

The late manifestations in thermal fever, coma, full bounding pulse, labored or stertorous breathing, and tissue asphyxia in fatal cases, can be accounted for by acidosis. Individuals probably vary a good deal with respect to likelihood of acidosis. In some cases, inferior ability to oxidize glucose (deficiency of insulin) may be a factor. Acidosis may be an important feature in heat exhaustion also, and depletion of bases through excessive loss of salts in drenching sweat may be an additional factor making for acidosis in such cases. Of late the medical journals indicate that some physicians are inclined to administer insulin in various forms of acidosis other than cases of diabetic origin. More often than not in heat cases the pancreas is capable of secreting all the insulin that is required. The difficulty is not due to failure to oxidize sugar but to very active oxidation and exhaustion of the immediate supply of glucose and consequent difficulty with the oxidation of fat. The indication is not to inject insulin but to administer glucose.

Sunstroke occurs quite frequently during the summer months in Chicago, New York, Boston, and other cities in the United States, but is rare in the tropics where trade winds almost constantly insure a strong breeze while the sun is high. Lack of air movement greatly increases the likelihood that thermal fever will develop. Direct exposure to the rays of the sun while the individual is surrounded by stagnant air, as when working in a ditch or other excavation, is well known to be potentially dangerous. Working in an overheated building or other shelter is likely to lead to heat exhaustion rather than to thermal fever, unless the air is so nearly saturated with moisture as to retard greatly the evaporation of sweat.

Heat Exhaustion (Heat Syncope) (Heat Cramps)

Heat exhaustion of greater or lesser degree occurs not infrequently during periods of hot weather in cities of the United States. Osler stated that true heat syncope is especially seen in persons who have not been in good health or who are intemperate. Exposure to heated

air is the exciting cause although one or more of a number of variables may be indispensable parts of the cause.

In the Navy the performance of hard muscular work, such as passing coal, tending furnace doors, making repairs in the hot engine room, etc., is almost always an attending circumstance. In some instances physical unfitness resulting from infection, confinement in the brig, intemperate use of alcohol, or loss of sleep during a liberty period has appeared to be a predisposing influence. Probably the amount of food and the kind of food eaten before and between steaming watches has its place in the etiology but, because of the lack of accurate data, correlation, if it exists, between the food consumed and the development of symptoms, can not be shown.

A good deal of heat may be radiated by metal decks, bulkheads, uncovered parts of machinery, furnace doors, etc., but radiation is not likely to be as prominent a factor as under the conditions where thermal fever usually develops. Cases of thermal fever are very rare on board ship. Cases of heat exhaustion are of infrequent occurrence in the firerooms of oil-burning vessels, even when the temperature in the fireroom is very high. The following table contains data for certain vessels on board which high temperatures were recorded in engine rooms or firerooms during full-power trials in 1925 and 1926, although no ill effects were noticed by the men at work in the overheated spaces:

Highest temperatures recorded in firerooms and engine rooms of naval vessels in the course of full-power trials in 1925 and 1926, without ill effect to personnel

Name	Outside air		Fireroom		Engine room	
	Temperature	Relative humidity	Temperature	Relative humidity	Temperature	Relative humidity
	°F.	*Per cent*	°F.	*Per cent*	°F.	*Per cent*
U. S. S. Lamson [1]	74	(2)	142	(1)	118	(2)
U. S. S. Hull [3]	62	94	130	24	130	37
U. S. S. Wood [4]	72	69	118	59	134	86
U. S. S. Beaver [5]	82	(2)	155	(2)	130	(2)
U. S. S. Aroostook [6]	57	55	128	12	102	30
U. S. S. Mervine [7]	64	(2)	126	15	102	26
U. S. S. Nitro [8]	75	(2)	130	(2)	120	(2)
U. S. S. Rochester [9]	78	(2)	132	(2)	118	(2)

[1] Men showed remarkable endurance and physical efficiency.
[2] Not stated.
[3] Physical standard of personnel was high and endurance excellent.
[4] Men proved physically qualified to perform their duties. In the firerooms there was sufficient movement of the air for the evaporation of perspiration and cooling of the body, but in the engine rooms, particularly the after engine room, the air was oppressively stagnant.
[5] Lack of sufficient movement of the air to promote the greatest degree of comfort possible with the high temperature was noted.
[6] The air was in sufficient motion to facilitate evaporation of perspiration and promote maximum work and comfort.
[7] Circulation of air sufficient to promote comfort in all working spaces. Men showed excellent stamina. Liberty expired one-half hour prior to commencement of the trial. No man showed diminished capacity for work as a result of liberty. No man suffered heat exhaustion or excessive fatigue.
[8] Good physical condition of men due to short watches and little muscular exertion.
[9] A coal burner. No case of heat exhaustion or heat cramps occurred in spite of the fact that 36 men from the deck force were detailed to work below. The watches were short—engine room, 2 hours on and 2 hours off; firerooms, 2 hours on and 4 hours off.

Office and living spaces of naval vessels are not infrequently overheated, day and night, while in the Tropics to a much greater degree than buildings in cities of the United States during hot spells, and yet the effects of overheating to degrees that would justify the term heat exhaustion are rarely observed among the personnel. Pathological overheating does not occur, chiefly because the air in overheated spaces is kept in motion by blowers and electric fans, and clothing that would interfere with the evaporation of sweat is not worn. After prolonged exposure to hot and humid air, day and night, for several weeks, officers and men of course welcome a change and relief from conditions that keep the skin moist or wet most of the time. After a time one loses his punch and tends to avoid muscular exertion, feels languid, and greater incentive is ordinarily required to face daily tasks involving muscular work.

But there is rarely any actual impairment in the efficiency of the body as a heat engine. The difficulty is with innervation and that is primarily due to bad mental hygiene arising from continual discomfort and monotonous environment. With an incentive strong enough to stimulate action, such as anger, competition in athletic sports, etc., the individual is apparently as capable of making great physical efforts and has as much endurance in running, boxing, etc., as if he had not been sweating most of the time for several weeks merely to keep his body temperature normal.

As remarked above, comparatively few cases of heat cramps and heat exhaustion occur in the firerooms of oil-burning vessels. In 1924, the last full year for which figures are available, there were 12 admissions to the sick list on account of heat cramps or heat exhaustion among men standing steaming watches in engine rooms of naval vessels and there were 48 among men on duty in firerooms, involving a total of 245 sick days. One case of heat exhaustion was fatal. No man was invalided from the service as a result of overheating. Of the 12 engine room cases, 7 occurred in coal-burning vessels and 5 in oil burners. Of the 48 fireroom cases, 34 occurred in coal burners and 14 in oil burners. The difference in hazards is much greater than these figures indicate. There are more oil-burning vessels and these were more actively employed than coal burners under conditions likely to involve overheating in firerooms and engine rooms.

The experience of the U. S. S. *Wyoming*, a coal-burning battleship, in 1925, illustrates quite well the conditions and circumstances that make for heat exhaustion. After a period of hard work for the fireroom and engine room forces incidental to maneuvers in Hawaiian waters the ship reached San Diego, Calif., June 18. During the eight days of steaming from Honolulu two cases of heat cramps oc-

curred among men in the firerooms. The medical officer, Lieut. Commander W. W. Hargrave, Medical Corps, United States Navy, reported that while the ship was in San Diego (four days) a great deal of repair work was done on the boilers. Liberty was granted and between the work and liberty at night the fireroom force had very little rest. The ship sailed June 22 for Panama. On the run down 56 cases of heat cramps or heat exhaustion occurred. The first case occurred one day out of San Diego; four the next day; and two the third day. During these three days the weather was comparatively cool and the firerooms were not greatly overheated. It was not apparent at the time why cases of heat cramps were occurring. Conditions had been much worse many times in the past, notably during full power trials, without affecting any man. The members of the fireroom force were trained men who had been conditioned by work in many hard steaming watches during the preceding cruise and maneuver period. Loss of sleep and lack of opportunity to recuperate after hard and continuous work in steaming and repairing boilers were factors. On the fourth day the weather was hot and oppressive. The temperature on deck varied between 81° and 90° F. The temperature in firerooms ranged from 121° to 131° F. That day, June 25, 19 cases of heat cramps or heat exhaustion occurred, followed by 26, 2 and 1, respectively, during the next three days. After June 28, no more cases developed. The ship arrived at Balboa, Canal Zone, July 1.

The weather was hot from June 25 to June 28. Admiral's inspection was held June 26 and 27. The medical officer observed that preparations for the inspection, drills, policing, etc., put the crew on edge and necessarily interfered with rest periods of the firemen during forenoon and afternoon hours. Those conditions together with long hard cruising previously and hard steaming at the time, high atmospheric temperature, oppressive humidity, overheating of the ship's living spaces, and high temperature in the fireroom appear to have accounted for this very unusual incidence—even for a coal-burning ship—of heat cramps and heat exhaustion among the fireroom force. No man in the engine rooms suffered any ill effect.

Doctor Hargrave remarked in his report of the occurrences that the engine room and fireroom forces as well as the rest of the crew had been living and working under trying conditions since January. Winter gunnery practice, extensive cruising, tactical maneuvers, and war game in Hawaiian waters on a greatly overcrowded, coal-burning ship, proved to be quite a strain on the men. This was particularly the case for men in the engineer's department, for the boilers were in bad shape and throughout the cruise required constant attention in the way of repairs and upkeep. When the hot

weather was suddenly encountered after leaving San Diego there was a noticeable " let-down " in the physical condition of both officers and men. It was observed that seasoned firemen fell by the wayside as well as new men and recruits from the deck force. Doctor Hargrave also observed that the greater number of men admitted to the sick list were from firerooms where forced draft was used and a smaller proportion from those where natural draft sufficed, although the temperature averaged 5 to 8° F. lower with forced draft.

The symptoms in cases reported as heat cramps were fever, usually about 100° F., moderate tachycardia, severe cramps in the abdomen and extremities, and occasionally vomiting. The duration of illness in most cases was about 48 hours. In the cases recorded as heat exhaustion, of which there were few in comparison with those in which the patients complained chiefly of cramps, the men were prostrated and had subnormal temperature when admitted. There were no cramps in those cases, the skin was cold and moist, and the pulse was very rapid. There were only six cases of that type.

Several factors are always involved in the production of overheating that eventually leads to heat prostration or to the development of heat cramps, but the combination of factors may not always be the same. In fireroom and engine room cases the final influence of determining importance is likely to be high temperature and high relative humidity of the outside air with little movement, or worse, a breeze from astern so that there is no movement of the air at all on deck. Under these conditions great overheating occurs in the compartments below, but the *Wyoming's* experience indicates that other factors are often necessary to cause more than an occasional case. The length of the voyage has a good deal to do with the development of cases. Men on watch are affected more often after several days of steaming at moderate speed than during 24-hour full-power trials. Other factors are work conditions on board in general, shortage of personnel, inadequacy of rest periods between watches, experience and training of the men, and physical condition at the time.

The performance of hard muscular work while exposed to overheated air is an essential factor in most but not all cases. In oil-burning ships where only moderate exertion is required in the fireroom, heat exhaustion seldom occurs even though the fireroom be hotter than is usually the case in a coal-burning ship. An occasional case of heat cramps or even prostration may of course occur under conditions that are not regarded as very uncomfortable by the rest of the men on watch. In such instances the affected indi-

vidual must be regarded as especially prone to overheat either because of inherent inability to eliminate heat rapidly or because of some temporary disability affecting skin efficiency or influence upon the rate of metabolism resulting from overeating. Food is probably a factor in many of the cases. As shown in a previous section of this article the ration as issued to the average man on board ship is overweighted with bread and meat. The amount of protein eaten by the average man is considerbly in excess of tissue needs and the proportionate amounts of proteins, fats, and carbohydrates are such that the hardworking, hungry individual, in satisfying his appetite, is likely to ingest a great deal more protein than can be metabolized without producing heat incidental to its destruction that will be added to the heat generated in the performance of muscular work while on watch. Furthermore, the metabolism of the protein involves the release of much acid requiring the equivalent amount of base for its neutralization prior to elimination. Excessive sweating while work is being done involves free excreton of sodium. The store of sodium and other bases may be sufficient to take care of the production of acid released purely as the result of muscular work but insufficient for the additional quantity involved in the destruction of an excess of ingested protein. It is doubtful whether men who eat heartily of meat, bread, and potatoes between steaming watches are likely to eat enough of vegetables and fruits, fresh or canned as the case may be, to ingest sufficient molecules of basic elements, in addition to the bases furnished by the potato, to neutralize the acids formed during the period of great exertion. The sodium ingested in neutral table salt is utilizable only to a limited extent. Some firemen have found that they feel better and have more endurance if they can consume large quantities of canned tomatoes. Tomatoes are useful for the water and carbohydrate they contain as well as for the base-forming ash. It would be interesting if medical officers would systematically collect data bearing upon the dietary habits of men who develop heat cramps or heat exhaustion by questioning them closely as to the food eaten. It is not unlikely that evidence strongly presumptive of a metabolic factor arising from the overingestion of protein and underingestion of base-forming foods would thus be brought to light in connection with the occasional cases that occur under environmental conditions that are not regarded as trying or intolerable for most of the men on watch at the time and performing equally hard labor.

Men in the overheated spaces who are not exerting themselves rarely develop symptoms. Free perspiration almost invariably is an immediate consequence of muscular work. An individual who can not pour out enough sweat to check his rising temperature and

hold it down to some extent would almost inevitably develop overheating of the thermal fever type. As a matter of fact such cases rarely occur in firerooms and engine rooms. Practically all men employed there do sweat. The other factor that tends to prevent thermal fever is that the air conditions are such that the sweat poured out can evaporate rapidly. Although the temperature of the air may be very high the percentage of water vapor is almost always low, the capacity of the air to absorb water having greatly increased in passing from the outside temperature to that acquired in the overheated space.

It is not possible from the statistics available to judge how many of the heat cases reported were examples of heat cramps and how many were really cases of heat exhaustion. It is doubtful if medical officers have discriminated very carefully between the two titles in reporting cases. And, as a matter of fact, it probably would not be worth while to divide the cases under these two headings. A man may have severe cramps and marked exhaustion with subnormal temperature. Another has cramps, moderate fever, and but little prostration. Another is greatly prostrated to a degree that makes the term "heat syncope" applicable, without experiencing cramps. There is probably no dividing line between the two types. Varying degrees of acidosis and varying effects produced by unneutralized acids or other products of metabolism probably account for differences in clinical manifestations.

In all cases considerable elevation of body temperature probably occurs in the earlier stages. In the exhaustion cases at a certain point production of heat ceases and the body begins to cool, the skin continuing to pour out sweat. Often the patient's temperature is subnormal when he reaches the sick bay.

Cessation of heat production eventually is brought about through action of the central nervous system. Possibly altered reaction of the blood circulating through the brain so affects nerve cells that reflexes are set up to inhibit muscular contractions. Subjectively, great weakness is felt and inability to make further effort with the skeletal muscles is experienced. Possibly one or more of the products of muscular activity circulating in the blood have a specific effect upon the brain cells.

Locally, in the muscles, there is a decreased rate of internal respiration of the cells and oxidation changes are not complete. Acids or other degradation products are formed and these accumulate in the tissue. Cramps may occur in various muscles as an immediate result of such local accumulations. Lactic acid is formed primarily as a degradation product in the oxidation of glucose, but very likely other compounds formed in the muscle are more irritating than lactic acid.

Oxygen used by the tissues is truly the measure of metabolic changes, but the liberation of energy in the organism, as in the contraction of a muscle, is not now regarded as the direct and immediate result of a definite quantitative oxidation reaction. Other chemical changes are thought to be immediately involved in bringing about the cellular activity, oxidation of material serving later to recharge the cells.

The manner of releasing energy is more analogous to the chemical changes occurring in a storage battery while work is performed than to the action of an internal combustion engine where a definite quantity of fuel is burned for each stroke of the piston. The cells are constantly being recharged while they are functioning.

Oxygen is required for both the internal and external work of the cell. Internal work refers to maintenance of the cell structure. It includes recharging the battery cell, as it were. External work refers to the functional activity of the cell; in the case of a muscle cell, contraction.

It appears from recent work done by Hopkins in England that oxygen is absorbed by means of a dipeptide, *glutathione*. Glutathione is a compound of cysteine and glutamic acid. Cysteine is the reduced form of the amino acid, cystine. Cysteine contains sulphur as SH. Cystine has been thought to be the only amino acid in food proteins containing sulphur but there is now the probability that some proteins contain sulphur in another form as a constituent of another, and as yet unnamed, amino acid. At any rate cystine sulphur appears to be indispensable in metabolism. Glutathione is almost certainly the main agency through which the tissue cells are enabled to absorb and utilize oxygen brought to them, and it may be that with glutathione not available the tissues can not breathe. It is not of particular interest in this connection whether glutathione is or is not the only compoud that makes it possible for the tissues to absorb oxygen. If not, the only inference is that the organism is able to make substitute use of some other compound presumably containing sulphur. In any case, a compound having affinity for or capable of activating oxygen must be available or the tissues can not absorb and utilize oxygen even though plenty of oxygen is being carried by the blood. Feeding experiments have demonstrated that cystine is one of the essential amino acids which the animal organism must have. It may be obtained either in the oxidized form, cystine, or the reduced form, cysteine, by hydrolyzing a protein that contains it. Proteins are not necessarily hydrolyzed to that extent in the body for the utilization of the sulphur. Possibly the sulphur is made use of for the most part more directly by splitting off the more complex compound, cysteine-glutamic acid (gluta-

thione). However, as suggested by Sullivan, Hygienic Laboratory, United States Public Health Service, the organism appears to have important uses for sulphur compounds aside from oxidation and reduction phenomena. The body uses sulphur as a detoxicating agent, and it is conceivable that excessive destruction of cysteine demanded for the bonding of toxic materials might, under some conditions at least, interfere with maintaining a sufficient amount of glutathione in all tissues to support tissue oxidation freely enough to prevent the accumulation of products of incomplete combustion.

Cystine, the oxidized form, has the formula:

$$\begin{array}{l} CH_2S—SCH_2 \\ CH.NH_2—CH.NH_2 \\ COOH—COOH \end{array}$$

This is di-beta thio-alpha amino-propionic acid.

Cystine is readily reduced in the body to cysteine by taking up two atoms of hydrogen. It has the formula:

$$\begin{array}{l} CH_2SH \\ CH.NH_2 \\ COOH \end{array}$$

The high reactivity of the sulphur compounds of the body is bound to a large degree with the sulphydryl group, SH, so probably it is the SH system that makes cysteine effective as a detoxicating compound.

The peptide compound, glutathione, which probably must be available constantly to all cells to effect the absorption of oxygen for cell metabolism alternately undergoes oxidation and reduction in the process of carrying on the internal breathing of the tissue cells. The formulæ are as follows:

Oxidized glutathione

$$\begin{array}{ll} CH_2S\text{------------------------------} & SCH_2 \\ CH.NH\text{-}CO.CH_2.CH_2.CH.NH_2.COOH\text{---} & CH.NH\text{-}CO.CH_2.CH_2.CH.NH_2.COOH \\ COOH\text{------------------------------} & COOH \end{array}$$

Reduced glutathione

$$\begin{array}{l} CH_2SH \\ CH.NH\text{-}CO.CH_2.CH_2.CH.NH_2.COOH \\ COOH \end{array}$$

It is possible that the sulphur in the food, ordinarily considered in terms of cystine, may really exist in utilizable form in the more complex molecule, glutathione, and that the latter is taken by the tissues for use. However, experiments in biological chemistry have shown that an animal subsisting on a protein that contains no cystine, when given pure cystine to supplement the incomplete protein, can use the latter for all requirements. In such cases glutathione is probably synthetized.

The subject of acidosis will be dealt with later from another angle in the section devoted to consideration of the diet with respect to base forming and acid forming foods, but a summary is useful here in considering regulation of body temperature, and the conditions which may bring about overheating of the body.

Hawk in his book, Practical Physiological Chemistry, defines acidosis as *a lowering of the alkali reserve of the body*. The volatile acid, carbonic acid, is the most abundantly produced acid. The reserve power of the blood to carry CO_2 is of course reduced. Under most conditions involving acidosis, which may arise from a good many different causes, other acids as well are produced in excessive amounts and at the same time the capacity of the organism to effect neutralization and transport the acid ions to the kidneys or other excretory organ is reduced. Acidosis may be brought about by the excessive depletion of bases within the body resulting from use in neutralizing excessive amounts of acids produced, or the depletion of bases may result in part at least directly from excessive elimination as in drenching sweats which occur in some infectious diseases and while muscular work is being performed in overheated spaces.

Increased production of acid is incidental to an increased rate of metabolism, but the result is not necessarily acidosis. The alkali reserve of the body may be, and under most conditions is, sufficient to prevent acidosis. For acidosis to occur the burning or oxidation of nutrients or tissue substance must be smothered. That is, there must be interference with free oxidation to the extent that products analogous to the products formed in the incomplete combustion of fuel in a furnace or engine are released. These may be called degradation products. Except for inability to secrete insulin and some lessening of free oxidation in a muscle that is performing hard work, combustion of glucose is almost certainly complete, the end products being carbon dioxide and water. This volatile acid is handled by the blood without strain because even in severe acidosis the reaction of the blood is scarcely altered, the organism possessing great power of resistance to change from the normal reaction of slight alkalinity.

Unneutralized acid that gets into the blood stream is excreted as quickly as the organism can get rid of it, and, as a further defense, acids produced in the tissues are left where they are formed when bases are no longer available to effect neutralization. The blood holds its neutral reaction to the last. Death must occur when the blood has lost so much of its essential bases that CO_2 can not be transported in requisite amount to prevent asphyxiation of the tissues. These bases are sodium bicarbonate, potassium bicarbonate, and the alkaline di-sodium hydrogen phosphate. They are not used up in transporting carbon dioxide because they are freed as carbon

dioxide is delivered to the lungs and thus again become available for the transportation of molecules of the volatile acid. That is not the case with the nonvolatile acids. If these are neutralized, neutral compounds are formed, transported and excreted, the base being eliminated with the acid radicle.

Incomplete oxidation of glucose results in the formation of the intermediary product, *lactic acid.* A certain amount of lactic acid is always produced in muscle tissue as a result of muscular work, but greater production and accumulation of this and other irritants occurs with lowered tissue oxidation. If the accumulation becomes great enough the muscle can not respond to stimuli. The cells can not function; the muscle has lost its power to contract, and cramping may occur.

Incomplete oxidation of fats results in the production of ketone bodies. Such bodies contain the CO radicle. Normally in the combustion of fatty acids, aceto-acetic acid is formed. The concurrent oxidation of glucose is neccesary for the normal further oxidation of aceto-acetic acid. If, through exhaustion of the reserve supply of glucose and glycogen and failure of a derived supply from protein, or because of deficiency of insulin, carbohydrate oxidation diminishes or ceases, reduction instead of oxidation of aceto-acetic acid occurs, and, by taking up hydrogen, Beta hydroxybutyric acid is formed. Aceto-acetic acid also splits into acetone and carbon dioxide.

Formulæ:

Aceto-acetic acid	$CH_3.CO.CH_2.COOH$.
Beta hydroxybutyric acid	$CH_3.CHOH.CH_2.COOH$.
Acetone	$CH_3.CO.CH_3$.

Normally, aceto-acetic acid is for the most part oxidized to acetic acid, $CH_3.COOH$, and the latter in turn to CO_2.

Normally, in the metabolism of proteins, carbonic acid, phosphoric acid, and sulphuric acid are produced. When there is interference with the internal respiration of the tissue cells resulting in suboxidation, additional acid products may be formed. It is wise at this point to speak of the possibilities in general terms and refer to intermediary products of oxidation and hydrolysis as degradation products or products of incomplete combustion.

Internal oxidation may be decreased by: (*a*) Failure of the blood to bring oxygen to the tissue in sufficient quantity (anoxemia), or (*b*) inadequate supply of or interference with the function of glutathione, leading to inability of the tissue cells to use the oxygen brought to them (Sullivan).

Failure of the blood to transport oxygen.—The causes of anoxemia are of course varied. Among these may be mentioned cardiac and

cardiorenal disease, diseases of the lung which interfere with ventilation of the blood, and anemias. Deficiency of oxygen, as at great elevation, could be a cause. The binding of hemoglobin with carbon monoxide can bring about anoxemia ranging in degree according to the concentration of CO in the air breathed and the duration of exposure to it. A concentration as low as 0.05 per cent eventually renders 50 per cent of the hemoglobin incapable of transporting oxygen. With the air containing 0.5 per cent, 99 per cent of the hemoglobin will become fixed. Acidosis is necessarily a feature of asphyxia when death does not occur promptly as a result of complete deprivation of oxygen.

Methemoglobin is superoxygenated hemoglobin. The oxygen is so combined for the time being that the red cells can not give up oxygen to the tissues. It is in the literature that methomoglobin is formed as a result of overexposure to the direct rays of the sun, and its formation thus brought about has been considered by some to be an important factor in the etiology of sunstrokes. The relative anoxemia so induced may indeed be among the causes leading to acidosis in such cases of thermal fever. But it probably does not play a leading rôle in bringing about the initial rise in body temperature. If it did, those who lie about on the sand at beaches for hours with much of the skin area exposed to the sun might be expected to suffer sunstroke more often than persons on city streets, and sunstroke might be expected to occur more often in the tropics.

Inability of the tissues to use oxygen though available.—As indicated above, recent discoveries seem to show that the ability of tissue cells to absorb oxygen under all conditions depends mainly and perhaps altogether upon the presence of glutathione. This dipeptide, by alternately undergoing oxidation and reduction, can effect the transfer of oxygen from hemoglobin to fixed tissue cells without being used up in the process. Demands for sulphur which may be obtainable from glutathione or perhaps from ingested cysteine, to serve as a detoxicating agent, with consequent fixation and excretion may result in depletion of the supply. Unusual demand for oxygen on the part of certain cells, especially muscle cells, may arise from an increased rate of metabolism resulting from increased temperature of the tissues or from the performance of hard muscular work.

Usually the increase in the rate of metabolism depends upon both muscular effort and inability of the skin to eliminate heat rapidly enough to prevent a febrile temperature. A vicious circle is conceivable in which an unusual demand for oxygen is not completely met; acids and perhaps even more damaging degradation products are formed; the store of reactive sulphur available as a detoxicating

agent is depleted, there is interference with the function of glutathione and the rate of oxidation within the cells is reduced even more in the face of increasing need for oxygen. This conception may or may not completely account for the development of the clinical manifestations in heat exhaustion cases. Acidosis is unquestionably a development in such cases, and that should be recognized in treating the patient, but it is possible that degradation products that can not be neutralized by sodium and other bases cause more damage to the organism than unneutralized acids. Calcium probably serves as a detoxicating agent, and deficiency of calcium in the diet may be among the causes leading to damage from great muscular exertion. It remains to be determined whether remedial effect can be secured by feeding sulphur. Blood serum contains more sulphur in utilizable form than any of the articles commonly used as food. Eggs contain more than other foods. On the chance that sulphur is needed, eggs may be given, if the patient is able to take them, along with sugar and with alcohol if the temperature is subnormal. The possibility that calcium is needed should be borne in mind.

In sunstroke cases the most pressing indication is the application of cold by hydrotherapy, rubbing with ice, etc., to rid the body of the great quantity of heat retained in the tissues. The introduction of glucose is indicated to prevent any further incomplete combustion of fat. The administration of sodium bicarbonate is indicated in moderate amounts to effect the neutralization of free acid in the tissues.

In heat-exhaustion cases the administration of glucose or cane sugar is indicated to furnish fuel that can readily be oxidized to heat the body up to normal temperature. At the same time the administration of sodium bicarbonate is indicated to replenish the supply of bases. For the prevention of heat exhaustion and heat cramps the drinking of oatmeal water is often recommended. It should be useful for its carbohydrate content, but beverages sweetened with sugar serve equally well. Lemonade contains base linked with weak organic acid and well sweetened lemonade serves well when the body is exposed to overheating to strengthen resistance to acidosis. In the fireroom, sodium bicarbonate may be useful. Sirup containing fluid extract of Jamaica ginger added to the drinking water serves well to meet the demand for readily combustible carbohydrate.

The sugar is the main thing, but many of the men feel that the effect of the ginger in the stomach helps to prevent cramps. Ingestion of alcohol while the man is on watch is likely to be followed by lessened ability to work. The administration of alcohol to a

man relieved from watch because of exhaustion and subnormal temperature, would seem to be a rational procedure when given along with the sugar and bicarbonate. The production of heat may begin sooner after the ingestion of alcohol and sugar together. Covering the patient with blankets to conserve body heat is a rational procedure. Naturally, hot-water bags would be placed under the blankets, but it is doubtful if any particular effect can be expected from the heat contained in them. Heat to raise the body temperature in the main must be produced within the body. Some little effect may be had by using several or many hot-water bags, or by putting the patient into a hot bath or by exposing him to air heated to a temperature higher than the temperature of the body.

Regulation of Body Temperature in Cold Weather

Chemical regulation of body temperature has been referred to above. When the physical method of conserving heat fails under any conditions, lack of clothing, cold air, strong wind, etc., the cutaneous nerves are subjected to a temperature lower than that required to promote a sense of comfort with the skin adjusted for minimum transfer of heat. Consequently, reflexes are set up that involve motor impulses leading to shivering, restlessness, etc., representing muscular contractions that require the oxidation of fuel and production of heat. This combustion of fuel for the sole purpose of generating heat has been termed chemical regulation of body temperature. Often voluntary movements of the muscles are made, or restlessness results with more or less involuntary use of the skeletal muscles until enough additional heat has been generated to bring a sense of comfort. A considerable number of additional calories may be required in the food to provide for such chemical regulation of temperature when light clothing is worn in cold weather out of doors or when resting in underheated rooms.

Increased tension in muscles can also lead to the production of additional heat without visible shivering. It is probable that the first stage in chemical regulation is increased metabolism in muscles undergoing such activity without a subjective feeling of chilliness. Adaptation to cold air or to cold baths may really mean that the muscles have become especially trained to respond readily in such manner to increased demands for heat. The individual is said to have become inured to the cold he can withstand comfortably while at rest. With exercise, of course, greater exposure can be borne comfortably. With training, many individuals can swim in ice-cold water without experiencing discomfort, or they say they can.

Lusk found, in the case of men immersed in baths containing cracked ice, that the energy required for regulating the body temperature was derived approximately half from carbohydrate and

half from fat. He states that cold tends to deplete the store of glycogen in the animal body and quotes Freund and Marchand as showing that a low environmental temperature increases the amount of sugar in the blood.

Wind greatly increases the rate of metabolism. Rubner showed that a breeze becomes perceptible when it attains a velocity of 0.4 to 0.5 meter per second, and that air movement well below this threshold value may increase heat loss in exposed areas of the body from 20 to 75 per cent. Lusk states that a breeze having a temperature of 59° to 68° F. and moving at the rate of 15 miles per hour has a greater effect upon the metabolism of a man clad in summer clothing than a temperature of 36° F. in still air.

Diurnal Variations of Body Temperature

In general, deviations from mean body temperature parallel diurnal variations in atmospheric conditions. A large number of temperature observations were made in the course of extensive investigations of the New York State commission on ventilation. Winslow states that the experiments dealt with the effect upon a large number of subjects of three atmospheric conditions: 68° F. with 50 per cent relative humidity; 75.2° F. with 50 per cent relative humidity; and 86° F. with 80 per cent relative humidity. At 75° F., dry bulb, the average rectal body temperature of the subjects was 2 per cent higher and at 86° F. it was 5 per cent higher than at 68° F., showing that the homoiothermy of the human body is after all only relative and not absolute, even within a moderate range of atmospheric temperature. Close relationship was found to exist between the rectal temperature at 9 a. m. and the mean air temperature for the 12 hours preceding. The curves were so parallel as to leave no reasonable doubt of the direct relation of cause and effect. With reference to conflicting reports of those who have compared variations in body temperatures in the Tropics and in the Temperate Zone, Winslow suggests that after a prolonged sojurn in a warm climate a compensating mechanism is developed which maintains a lower body temperature with a given atmosphere outside.

Doubtless the average individual is capable of making necessary adjustments quite rapidly to meet changing climatic influences. Readjustment of the metabolic rate is required frequently in the Temperate Zone with changing weather conditions. While heat production may be required at more or less constantly changing levels to maintain body temperature within a comparatively narrow range of deviations from mean normal body temperature, 98.4°, 98.6°, or 98.8° F. when marked changes in atmospheric temperature are occurring, there is a very strong tendency for body temperature to follow every day the cycle of changes in atmospheric temperature oc-

curring in any given locality due to the influence of the sun in modifying temperature and relative humidity conditions hour by hour during the day and night.

Lusk states that change in the normal routine of life so that one sleeps in the daytime and is awake and active at night, brings about an inversion of the curve of body temperature. Such change in manner of living may or may not reverse the cycle of deviations from mean body temperature. Other things being equal the least production of heat will of course occur while the subject is sleeping and the greatest while he is working. Lusk remarks that Benedict was unable to obtain any inversion of normal body temperature in men who worked during the night and slept during the day. He remarks also that Gibson, who traveled halfway round the world, from New York to Manila and then returned, found that the rhythm of daily variation was dependent on the time of the solar day regardless of the part of the world in which he happened to be.

METABOLISM IN STARVATION

In the fullest sense of the word, starvation means primarily the complete deprivation of food and water; secondarily the state of the individual during the period of deprivation. As defined in Taylor's Medical Jurisprudence, fasting is voluntary abstinence from ingesta as distinguished from involuntary abstinence. By some writers the term, starvation, implies death resulting from deprivation of food or of food and water.

According to the Reference Handbook of the Medical Sciences, 1923 Ed. (Preble), a distinction between death from want of food and death from want of water can not be absolute. If deprived of water for several days a subject can no longer take or assimilate food. With water available an individual can dispense with food under favorable conditions for very long periods.

With regard to animals, Richet's law states that the smaller the animal the more rapid its combustion and the greater the rate of dehydration by the lungs. There are certain exceptions to this law. Dogs do not sweat and they do not become dehydrated when fasting. With water and without food a guinea pig will usually live only 6 days; a rabbit 12 days; a dog from 30 to 40 days, and in some exceptional cases 60 to 80 days.

The period of survival for man varies a great deal. A normal well-balanced man may not survive longer than 20 days with a liberal allowance of water. On the other hand many professional fasters appear to have suffered no great damage from total deprivation of food, water being ingested as needed or desired, for periods of from 30 to 40 days. Merlatti, a celebrated faster survived after

a fast of 50 days. Accurate figures concerning the survival of men deprived of both food and water are not available, but 10 or 12 days is the duration recognized in forensic medicine. These figures apply to strong and well-nourished subjects in the prime of life under favorable environmental conditions.

In the fasting state there is a painful sense of hunger which is most intense about 24 hours after the last ingestion of food. After that the sensation of hunger becomes less, but it probably never ceases entirely. In the absence of fluids it is supplanted with a torturing thirst. Lusk states that water, coffee, tea, beer, wine, and brandy relieve the sense of hunger when taken into the stomach, though water is least effective. In fasting there is usually a loss of buoyancy of spirit, decreased desire to work, and actual decrease in the power to work.

Cause of Death in Starvation

There is considerable difference of opinion as to the final or immediate cause of death, ranging from the idea that in the end oxidation in all tissues ceases as the result of failure of the central nervous system, brought about by demineralization of brain cells or by autotoxemia, to the conclusion of E. Voit that death is primarily due to loss of substance in organs important to life or to deficient nutrition of vital organs. Lusk states that the cause of death seems to be due to a reduction of activity in one or more organs important for life. None of these assumptions seems to explain just how and why tissue breathing comes to an end. In the light of recently acquired knowledge, depletion of cysteine should be taken into consideration. Further knowledge of the action of vitamins and of the effect of gradual exhaustion of the store of vitamins in the body is probably needed before complete understanding of the mechanism can be had.

Under some conditions death is said to result more quickly from partial starvation, as during a famine, when small quantities of foods not well adapted to human consumption are ingested, the diet as a whole being defective in various respects, including deficiencies of vitamins, than when no food of any kind is available.

Among the Eskimos there is a firm belief, according to those who have been among them in the Arctic regions, that it is very dangerous to break an enforced fast of even a few days duration by eating the food that ordinarily serves well as the ration when mushing. The doctrine seems to have been handed down to them from the experience of preceding generations that eggs must be used to break the fast. Such eggs as are obtainable from birds in the far north are collected, cached at stations along the trails for emergencies, and by

common consent respected by all travelers. No more are used than necessary for the relief of one who has been obliged to travel without food through loss or depletion of his supplies. Generally a single egg is swallowed at hour intervals for two and at most three or four feedings, and the subject is then required to sleep before eating a hearty meal. It is said that white Canadians who have disregarded warnings and have filled their stomachs immediately with flour, bacon, etc., upon reaching a station where food was available, and have then gone to sleep, as they naturally would, being in need of rest and sleep, have generally never awakened again. Milk is of course not available for the purpose, but theoretically it would probably serve to prepare the organism for other nutrients. It is possible that vitamins play an important rôle here and that disaster results from the ingestion of foods that are lacking in these essential factors. Mineral content is another factor to be taken into consideration, and it may be that those who have died as a result of such indiscretion have eaten heavily of protein and fat without carbohydrate so that sudden intense acidosis developed due to the fact that the body's store of carbohydrate had for the most part been exhausted.

The effect of prolonged fasting naturally depends upon the physical condition of the individual at the beginning of the starvation period. As mentioned above, there are different levels or planes of nutrition with respect to storage of nitrogen. The stored nitrogen has been said to be retained possibly in the form of so-called "deposit protein." A store of fat, adipose tissue, sufficient to spare protein or check the excretion of nitrogen to the end of the period is also an important consideration, and another is the ability of the individual to oxidize fat completely and thus escape damaging acidosis. It appears that ability to oxidize fats completely without depending upon any ingested carbohydrate can be increased in the case of many individuals, at least through practice, as by repeatedly fasting. It is possible that complete oxidation of fat in the fasting state is secured through the constant formation of an ample quantity of glucose from protein. Fat subjects and indeed very obese persons do not seem more prone to develop acidosis while fasting than thin subjects.

The urines of animals and human subjects frequently contain albumin during the fasting state. The quantities of Beta-oxybutyric acid and acetone in the urine become very great in most cases as the period of fasting continues after three weeks.

As might be expected, protein metabolism in general has been found to be relatively low in fat subjects while fasting. Protein metabolism also seems to be lower in the case of a subject who has previously practiced fasting, but, in general, the quantity of protein destroyed in starvation depends upon the amount of fat in the body.

During the first day or two the amount of body protein destroyed depends chiefly upon the amount of glycogen previously stored in the liver and muscles and upon the extent to which the individual carries a plus nitrogen balance into the starvation period. Protein metabolism is of course reduced by the oxidation of carbohydrate more than by the oxidation of fat. In cases where there is little glycogen to draw on, protein destruction is high even on the first day.

Ordinarily, in the fasting state, amino acids or amino-acid complexes are withdrawn from the glandular organs, muscles and certain other tissues, passed to the blood and carried to all organs for the nutrition of their cells. Even in prolonged starvation the blood is found to contain circulating amino acid compounds other than those of constituent blood proteins.

When there is much " deposit protein " to begin with, the amount of protein destroyed, as represented by nitrogen excreted in the urine, may be unusually great during the first few days or until the subject has been reduced to the lowest level of protein nutrition corresponding to what would require the least amount of ingested protein to establish nitrogenous equilibrium if the subject were eating. After this stage has been reached the destruction of protein goes on for many days at a rate that is quite constant for all subjects.

In the starvation state the full extent of protein metabolism may not be represented by the quantity of nitrogen eliminated in the urine, because amino acids may be transferred from the skeletal muscles to the heart or central nervous system for repair and upkeep of those tissues, and certain fractions of the skeletal muscle protein destroyed for such purpose would undergo transformation to glycogen or sugar which will eventually be oxidized without any nitrogen being excreted as a measure of the protein thus destroyed.

The heart undergoes little or no loss in weight.

Experiments have shown that if the fasting subject is kept at an even temperature and completely at rest or required to do an equal amount of work each day, the rate of total metabolism is remarkably constant from day to day during comparatively long periods of starvation. An average of about 90 per cent of the total energy requirement for work and heat may be derived from nonprotein material. The amount of protein destroyed while the subject remains in good condition bears a constant relationship to total metabolism.

Lusk cites the experiment made by Johanson, Landergren, Sondén, and Tigerstedt on the metabolism of a fasting medical student who performed light work while in the calorimeter chamber. On the fifth day, according to calculations, he oxidized 71.7 grams of

protein and 181.2 grams of fat, producing 1,971 calories, or, 31.23 calories per kilogram of body weight. Lusk states that this is probably the minimum metabolism compatible with ordinary life. He gives the following figures representing average results of many experiments by Benedict:

Average calories per kilogram

First day	30.7
Second day	31.8
Third day	31.0
Fourth day	29.6
Fifth day	28.5

The minimum heat requirement in the fasting state seems to be quite constant for different men. The proportionate amounts of protein and fat destroyed by different subjects are also about the same. As a rule, about 13 per cent of the total energy is derived from protein and 87 per cent from fat while fat is available.

After many days of fasting the quantity of nitrogen excreted in the urine falls much below the amount excreted in earlier days. According to Lusk about 3 grams of nitrogen, or the equivalent of about 18.75 grams of protein destroyed, would seem to be the lowest extreme of protein metabolism consistent with life in the emaciated organism after a prolonged period of starvation.

Lusk, with a view to making a useful summary of certain metabolic conditions in the starvation state, refers to Benedict's work with an individual who fasted for 31 days. Benedict found no evidence of any disturbance of the higher mental functions of the subject. He found a lowered power of endurance during the fast, but as disclosed by tests made a year later there was no lasting effect either upon muscular strength or mental activity. He mentioned that no feces were passed during the entire fast. During the 31 days the subject lost 277 grams of nitrogen by elimination in the urine. His original estimated content of nitrogen was 1,788 grams, indicating a loss of 16 per cent of the total nitrogen of the body. The following figures indicate the rate of total metabolism during the starvation period:

	First day	Eleventh day	Twenty-first day	Thirty-first day
Body weight, pounds	131	118	111	104
Calories per kilogram in 24 hours	24.2	22.1	20.4	22.6
Total calories, 24 hours, subject completely at rest	1,441	1,193	1,032	[1] 1,072
Per cent of total calories furnished by protein	10.6	19.6	16.5	14.4

[1] 1,025 calories on the thirtieth day.

In the course of a very prolonged period of fasting the time must come when there is no considerable amount of fat left in the body. With fat no longer available, protein destruction increases. Usually a gradual rise in protein metabolism occurs. This is known as the "premortal rise." It is reflected by the increasing elimination of nitrogen in the urine, and it is of course due to the continued demand for energy while the supply of the protein sparing fat is constantly decreasing.

Under equal work and heat requirements loss of body weight is about ten times as great when protein is the only source of energy as when fat is available for combustion. One gram of muscle substance (about 20 per cent protein) yields only 0.8 calories, whereas 1 gram of fat yields 9 calories, or perhaps a little more.

Experiments indicate that skeletal muscles and glandular organs suffer the greatest losses of tissue substance other than fat, and that the heart, bones, brain, and spinal cord suffer the least. So long as fat deposits are not exhausted, fat or constituents of the fat molecule are transported by the circulating blood to muscles and organs in need of fuel.

Glucose is present in the blood to the last. Sugar is probably produced constantly in the course of starvation protein metabolism. Glycogen is greatly reduced as a rule in the starvation state, but in the case of one dog glycogen was still present after 73 days. It has been shown that glycogen is formed during a period of starvation under some conditions at least.

A fasting man at work, provided his store of fat has not been exhausted, does his work entirely at the expense of fat, there being no increase in protein metabolism as the result of muscular activity.

The temperature of a fasting man or animal usually remains normal until a few days before death when it gradually falls below normal.

(To be continued)

EPIDEMIOLOGICAL REPORT OF AN OUTBREAK OF CEREBROSPINAL FEVER AT UNITED STATES NAVAL TRAINING STATION, GREAT LAKES, ILL.

By J. M. Minter, Commander, Medical Corps, United States Navy

Cerebrospinal fever made its appearance on this station February 16, 1926, in a recruit, C. D. W., of Company No. 78, enlisting at Denver, Colo. This patient presented himself at the sick bay, complaining of severe prostration, projectile vomiting, purpuric rash, and a temperature of 104° F. No meningeal symptoms were elicited. He was immediately transferred to the United States

Naval Hospital, Great Lakes, Ill., with "diagnosis undetermined (gastro-enteritis, acute)." A definite diagnosis was not established until February 23, 1926, the date on which the second case (R. A. F., of Company No. 77) was transferred to the hospital with a diagnosis of catarrhal fever, acute, which was subsequently changed to cerebrospinal fever. The first two cases were particularly puzzling, due to the presence at the time of an epidemic of mild influenza and the absence of early meningeal symptoms. After the presence of meningitis had been definitely established, a routine blood examination was made on all patients transferred to hospital and the combination of a high white blood count, severe prostration, vomiting, diarrhea in some cases, cephalalgia, purpuric rash, and temperature ranging from 102 to 104.5 made the diagnosis fairly certain. All suspicious cases were immediately transferred to hospital, as it was not deemed advisable to retain them at the sick bay until a definite diagnosis had been established. A total of 14 cases occurred; all in recruits, the first case coming from Denver, Colo. Three cases were fatal.

The following table is a summary with respect to home environment, place of enlistment, date of arrival on station, and date of first symptoms of meningitis:

Name	Age	Company	Arrived on station	First symptom of meningitis	Enlisted	Reared	Immediate preexisting disease
C. D. W.	19	78	Jan. 26, 1926	Feb. 16, 1926	Denver, Colo.	Colorado Springs, Colo.	None.
R. A. F.	19	77	do	Feb. 23, 1926	Minneapolis, Minn.	Williston, N. Dak.	Do.
J. E. M.	18	81	Feb. 12, 1926	Feb. 27, 1926	San Francisco, Calif.	Montague, Calif.	Do.
K. E. W.[1]	18	78	Jan. 23, 1926	do	Cincinnati, Ohio.	(?)	Do.
F. W. N.[1]	21	80	Feb. 8, 1926	Feb. 28, 1926	Omaha, Nebr.	(?)	Do.
J. C. G.[1]	17	81	Feb. 15, 1926	Mar. 1, 1926	Portland, Oreg.	(?)	Do.
U. J. P.	17	79	Jan. 28, 1926	Mar. 3, 1926	Milwaukee, Wis.	Stevens Point, Wis.	Do.
P. H. D.	19	77	Jan. 25, 1926	Mar. 5, 1926	Detroit, Mich.	Bowling Green, Ohio.	Do.
L. A.	17	80	Feb. 8, 1926	Mar. 3, 1926	Los Angeles, Calif.	Los Angeles, Calif.	Do.
R. M. Z.	17	81	Feb. 16, 1926	Mar. 7, 1926	Des Moines, Iowa.	Whittmore, Iowa	Do.
R. C. H.	18	79	Feb. 4, 1926	Mar. 8, 1926	Kansas City, Kans.	Chicago, Ill.	Do.
J. V. B.	17	81	Feb. 13, 1926	Mar. 11, 1926	Des Moines, Iowa.	Farmhamhill, Iowa.	Do.
B. B. S.	20	81	Feb. 12, 1926	Mar. 19, 1926	Portland, Oreg.	Joseph, Oreg.	Isolated and under observation for mumps for 19 days.
E. L. H.	17	80	Feb. 8, 1926	do	Louisville, Ky.	Farm in Kentucky.	None.

[1] Died.

The recruits in the receiving unit are quartered in brick buildings subdivided into dormitories large enough to accommodate 16

men to the dormitory. For a few weeks prior to the present outbreak the necessity of diverting a large number of recruits to this station so congested our present facilities that it was necessary to quarter from 22 to 24 men in each of these detention dormitories. At present there are 12 such compartments used for this purpose. From February 1, 1926, to March 1, 1926, 492 recruits were received at the detention barracks, which so congested the available facilities that it was necessary to transfer men from the receiving barracks to the main side of the station prior to the expiration of the usual detention period. On the main side there are 4 brick barracks subdivided into 16 dormitories of the following dimensions: 43 feet wide, 73 feet long, and 14 feet high. Due to the occurrence of several cases of cerebrospinal fever at San Diego Training Station it was deemed advisable to divert the western recruits to this station temporarily during parts of January and February. It is the custom on this station to sterilize all mess gear with live steam after each meal. After the discovery of the first case of meningitis all the companies were segregated and kept intact, both in messing and living conditions.

The following table is a summary of the individual organizations:

Company	Number of men	Number of cases	Number of men showing positive cultures on blood agar	Positive blood agar producing gas in maltose broth
75	118	0	6	2
76	127	0	4	4
77	122	2	9	3
78	134	2	8	3
79	122	2	8	3
80	124	3	11	6
81	122	5	12	3
82	99	0	12	5
Outgoing (detention) unit	68	0	8	2
Total	1,036	14	78	31

The weather during January and February was extremely inclement. Snow and rain alternated with disagreeable regularity. Weather conditions prevented any probability of fatigue, but exposure, chilling, and wetting must be considered as probable factors.

All men were quartered and messed under practically identical conditions. Companies 75, 76, and 82 remained free from the disease. Company 82 was the most recently formed company and was quartered in the detention barracks, entirely segregated from the other companies.

While chickenpox, scarlet fever, and measles were very prevalent in this vicinity during the period in question, still this station remained comparatively free from these diseases. It is not believed that any correlation between them has any significance. The following table shows number of admissions for other communicable diseases on the station during the epidemic period:

Disease	January	February	Mar. 1 to 15	Total
Chickenpox		1	1	2
German measles		1		1
Mumps			1	1
Scarlet fever			1	1
Angina, Vincent's		1		1
Bronchitis, acute	1	12	16	29
Catarrhal fever, acute	24	55	69	148
Tonsillitis, acute	13	24	57	94

An outbreak of mild influenza (diagnosis, catarrhal fever, acute) made its appearance on January 8 and a total of 148 cases occurred between this date and March 15. While these cases were extremely mild, and ran their courses in two to four days, it is believed that the lowered physical resistance thus encountered combined with extremely unfavorable weather and overcrowded conditions, made a fertile field for an outbreak of meningitis.

Tables showing the epidemiological conditions in the liberty areas (Chicago and Waukegan, Ill.) are as follows:

Disease	Weekly morbidity report of Chicago for the week ending—						Waukegan, Ill., for period Feb. 1 to Mar. 15, 1926
	Jan. 29	Feb. 5	Feb. 12	Feb. 19	Feb. 26	Mar. 5	
Measles	61	108	99	151	114	153	11
Scarlet fever	133	159	166	179	139	129	33
Whooping cough	51	41	86	63	86	44	
Diphtheria	54	54	65	51	62	65	
Influenza	7	10	15	10	35	58	
Cerebrospinal fever	1	1	1	1	1	1	
Pneumonia	223	262	322	351	322	429	19
Chickenpox							10
Mumps							4

The following table shows the dates on which the companies were given cowpox and antityphoid vaccinations and chronological relation to known cases of meningitis. Typhoid inoculations were discontinued as soon as the epidemic was discovered, except in companies receiving third inoculations:

Company	Vaccinated against smallpox	Inoculated against typhoid fever	First symptoms of cerebrospinal fever
77	Jan. 26, 1926	First, Jan. 26, 1926. Second, Feb. 3, 1926. Third, Feb. 9, 1926.	First case, Feb. 23, 1926 Second case, Mar. 5, 1926.
78	Feb. 4, 1926	First, Feb. 4, 1926. Second, Feb. 10, 1926. Third, Feb. 16, 1926.	First case, Feb. 16, 1926. Second case, Feb. 27, 1926.
79	Feb. 5, 1926	First, Feb. 5, 1926. Second, Feb. 11, 1926. Third, Feb. 17, 1926.	First case, Mar. 3, 1926. Second case, Mar. 8. 1926.
80	Feb. 12, 1926	First, Feb. 12, 1926. Second, Feb. 18, 1926. Third, Feb. 24, 1926.	First case, Feb. 28, 1926. Second case, Mar. 3, 1926. Third case, Mar. 19, 1926.
81	Feb. 18, 1926	First, Feb. 18, 1926. Second, Feb. 25, 1926. Third, Mar. 9, 1926.	First case, Feb. 17, 1926. Second case, Mar. 1, 1926. Third case, Mar. 7, 1926. Fourth case, Mar. 11, 1926. Fifth case, Mar. 19, 1926.

For many months past it has been the custom at this station to sterilize the mess gear with live steam in clusters of "steam cookers" after the mess gear has been run through the washing machine. The writer can not recommend too highly this method of sterilization when supervised and properly executed. Companies furnish their own messmen, who are changed weekly. From the number of cases occurring in the several separate organizations it is not believed that the diet or any condition connected with the handling and serving of food bore any causal relationship to the present outbreak.

As soon as the presence of cerebrospinal fever had been definitely established, systematic culturing of the recruits was undertaken. Cultures taken from the naso-pharynx by means of a bent-wire applicator with sterile cotton tip, were grown on blood agar plates for 36 to 48 hours. All suspicious colonies were subcultured on maltose broth. Out of 1,036 cultures made, 78 were deemed sufficiently suspicious to warrant segregating the men until subcultures could be interpreted. Transfers from 31 of these 78 suspicious plates were found to produce gas in maltose broth, and the individuals concerned were isolated as carriers. A total of 1,996 cultures were made. Two men showing negative cultures later developed cerebrospinal fever, but none of the known carriers developed the disease. Of the two cases showing negative cultures but developing the disease, one had been isolated under observation for mumps for a period of 19 days prior to the onset of meningitis symptoms. All the other meningitis cases developed symptoms prior to the time that was necessary to make and interpret cultures. The absence of

meningeal symptoms in several of the cases is explained by the negative spinal fluid findings but positive blood cultures as determined at the hospital. It is not believed that the culture work undertaken had the slightest value in limiting the number of cases, but the quieting effect this procedure had on the morale of the personnel under such circumstances partly repaid for the trouble thus taken.

The experience had on this station during the present epidemic confirms and justifies all the statements made by the Surgeon General of the Navy relative to cerebrospinal fever in his annual report for the year 1925.

AN OUTBREAK OF FOOD POISONING ON BOARD THE U. S. S. "CINCINNATI" ATTRIBUTED TO CORNED-BEEF HASH

Reported by Lieutenant Commander B. F. Norwood, Medical Corps, United States Navy

An outbreak of food poisoning occurred on board this vessel on December 8, 1925, affecting 40 members of the crew. The symptoms were those usually observed during an outbreak of this nature; *i. e.*, nausea, vomiting, abdominal cramps, with varying degrees of prostration, dizziness, and muscle pains. The symptoms ranged from mild to severe. All recovered within six hours, except three who complained of feeling weak and were kept in the sick bay overnight. Fried corned-beef-hash, believed to be the exciting cause, was served at breakfast on the day of the outbreak. The corned beef was removed from the tins the night before, mixed and placed in a warm steam-jacketed copper until the next morning, which permitted about 10 hours incubation, when it was fried and served.

The menus for the two previous days were as follows:

Sunday, December 6

Breakfast	Dinner	Supper
Plain toast.	Celery soup.	Fricassee of veal.
Ham omelette.	Breaded veal cutlets.	Mashed potatoes.
Fried potatoes.	Candied sweet potatoes.	Green peas.
Bread, butter, and coffee.	Creamed cauliflower.	Bread, butter, and coffee.
	Neapolitan ice cream.	
	Bread and coffee.	

Monday, December 7

Breakfast	Dinner	Supper
Fresh fruit.	Macaroni soup.	Chili con carne.
Fried eggs.	Roast beef and gravy.	Steamed rice.
Fried potatoes.	Pan roast potatoes.	Lettuce salad.
Bread, butter, and coffee.	Fresh buttered beets.	Fruit jam.
	String beans.	Bread and tea.
	Mince pie.	
	Bread, butter, and coffee.	

Tuesday, December 8

Oatmeal—fresh milk.	Vegetable soup.	Braised beef.
Fried corned-beef hash, with soft boiled eggs.	Boiled beef and spinach.	Baked potatoes.
Hot corn bread, butter, and coffee.	Boiled cabbage.	Fried egg-plant.
	Boiled potatoes.	Rice pudding.
	Sour pickles.	Bread, butter, and tea.
	Bread and coffee.	

The corned-beef tins were retrieved from a navy yard railroad garbage car immediately after the first case appeared and were held for laboratory investigation, even though outside contamination had undoubtedly taken place in approximately eighteen hours since being discarded. One beef tin and a specimen of stool from one of the sickest patients, with a specimen of urine, obtained by catheter under strict asepsis, from another, were sent to the laboratory of the United States Naval Hospital, Brooklyn, N. Y.

A culture from the beef tin showed a gram positive coccus and a gram positive spore-bearing bacillus, both of which were apparently saprophytic. The feces on culture showed a motile, gram negative, nonspore-bearing bacillus, which, by fermentation reactions, was identified as *Bacillus coli communis*. Samples of hash, cooked or uncooked, were not available. The tin upon which rested the most suspicion, when found, presented no discoverable dents or pin holes which would permit spoilage or contaminating influences, but showed several large areas of heavy oxidation of the metal as against the uniform darkening of the insides of the tins not suspected.

The degree of severity of symptoms corresponded to the amount of hash eaten. Several stated one or two bites only were eaten and these patients were only mildly nauseated, did not vomit, and had one or two loose, but not typically diarrheal, stools; on the other hand, those who ate a regular portion were sickest. The outbreak was not confined to any special mess or division, men of all branches, except C.P.O.s, being affected.

Summary of investigation.—(*a*) The corned-beef hash was mixed and allowed to incubate in a warm steam-jacketed copper for approximately 10 hours. This was believed to be the cause of the outbreak.

(*b*) There was no evidence of spoilage of fragments of beef in suspected containers retrieved from garbage car, but there were heavy darkened patches on inside of tin suggestive of oxidation of metal probably due to a pin hole opening admitting air.

(*c*) Ship's cooks and assistants were not affected with diarrhea or other infectious disease.

(*d*) All messes, except chief petty officers', were affected. Contamination by a carrier among mess cooks was thus ruled out.

(*e*) Two or three hours after eating the suspected food all patients experienced slight nausea, lassitude, and fleeting abdominal pains.

A fairly copious bowel movement was experienced by half; a single vomiting spell by 10 per cent.

(*f*) About 15 or 20 minutes after eating the noon meal profound symptoms became manifest in 26 men. The remainder were rounded up by the medical officer and treated, though symptoms were not severe enough to cause them to report voluntarily for treatment.

(*g*) The noon meal is not believed to have been a factor, as mild symptoms began to appear two or three hours after breakfast, and these became profound in men who ate no dinner as well as in those who did.

(*h*) Chili con carni served at supper the preceding day was made from remnants of roast beef served at dinner that day and cooking was started immediately after preparation and continued for over two hours.

(*i*) Urine and feces from a patient who had profound symptoms were cultured, but no microorganisms having the morphological and cultural characteristics of the *B. enteritidis-paratyphoid* group were found.

The supply officer and medical officer have repeatedly instructed the galley force in the danger of preparing canned or fresh meats and allowing to stand several hours before cooking. The shortage of help in the galley due to leave and liberty prompted the ship's cook to violate these instructions.

AN OUTBREAK OF FOOD POISONING, MILD IN CHARACTER, AT THE UNITED STATES NAVAL HOSPITAL, NEW YORK, ATTRIBUTED TO CANNED MILK USED IN MAKING ICE CREAM

An outbreak of diarrhea and abdominal cramps, regarded as food poisoning in mild form, occurred at the hospital Sunday, March 21, 1926. Patients in all parts of the hospital, and medical officers and hospital corpsmen alike, were affected, but no nurse was affected.

Upon investigation it seemed most probable that canned milk used in making ice cream was responsible. It was found that an average of about one can of bad milk per case is usually present in the stock of canned milk used, and it was considered that a can of slightly spoiled milk could easily have gotten into the ice cream without being detected.

So far as known, 85 persons were affected—about 30 per cent of those who ate the ice cream.

The first symptoms appeared between 3.30 and 4 p. m.; that is, three and one-half to four hours after the suspected food was eaten. One patient had eaten nothing but ice cream during the day. One patient had eaten only ice cream and macaroni. Three patients had eaten only ice cream and soup. Two of those attacked ate only the midday meal in the hospital, the meal at which the ice cream was

served. In every case ice cream had been eaten except by one man who also had diarrhea. In his case the disorder probably resulted from other causes. His diarrhea continued; in all other cases it was transient or of brief duration.

Canned pineapple was used as the flavoring of the suspected ice cream. The pineapple was not believed to be responsible for poisoning because it is very unusual to find a bad can, and the cans are larger, so a bad can would not be likely to escape detection.

Ice cream was also served to the nurses at dinner that day. It was made in the same utensils and frozen with the same apparatus by the same attendants but neither canned milk nor canned pineapple was put into that ice cream.

EPIDEMIOLOGICAL STUDIES OF MEASLES AND CERTAIN OTHER COMMUNICABLE DISEASES BY THE HEALTH DEPARTMENT OF DETROIT

The following information was taken from various numbers of the weekly health review published in February, March, and April, 1926, by the department of health, city of Detroit:

During the month of January there was an unusual prevalence of measles in Detroit. A total of 4,355 cases was reported as compared with 22 in January, 1925, and 336 in January, 1924. Under ordinary circumstances physicians of the health department diagnose from 8 to 14 per cent of the measles cases reported. In 1925 they diagnosed 14.1 per cent of the measles cases. Of the 4,355 cases reported this January they diagnosed 1,134 or 26 per cent. This increase was undoubtedly due to the fact that upon the opening of schools after the Christmas holidays the department placed extra physicians and nurses in the schools to look for children with early symptoms of measles. It was hoped that by finding such persons and isolating them early the number of secondary cases could be cut down appreciably. Just how successful we have been is not known, for obviously we do not know how many cases would have developed had nothing been done.

Has intensive measles work done anything else except to discover more cases of the disease? We believe that it has, in bringing about a general feeling that medical attention is necessary for measles. In all cases coming to our attention we have advised medical care. Pneumonia is, of course, the great danger in measles, and whenever there is a very considerable increase in measles without medical attention—especially in the winter—the case fatality rate rises on account of pneumonia. Ordinarily measles is more prevalent later in the year when pneumonia is somewhat less likely to occur. The present increase in measles in January, when pneumonia is especially

prevalent, might reasonably be expected to give rise to a considerable increase in deaths. The number of deaths per 100 cases of measles has ranged from 2.8 to 0.97 in Detroit during the past five years; the average has been 2.2. The rate for this January was 1.12, or only a little over half the average rate. While it is true that the better reporting of cases, which invariably results when a disease is particularly prevalent, may have had some effect on the rate, it is unlikely that this fact alone would have caused such a marked reduction when we should expect a considerable increase. We believe that the more universal practice of procuring medical attention has kept the case fatality rate below normal.

If you have never had measles and are exposed to it, what is your probability of contracting this disease?

A study of 305 families in which there were one or more cases of measles reveals the fact that in these families there was a total of 612 persons who had never had measles. Deducting the 305 primary cases, leaves 307 persons who were exposed to these cases who had not previously had measles. Among these 307 persons there developed 188 cases. In other words 61.2 per cent of the susceptible contacts contracted the disease.

The following table gives the number of susceptible exposures of various ages and the numbers and percentages of cases occurring among them. These figures include the 305 primary cases:

Susceptibles and cases occurring among them in 305 families having one or more cases of measles during January, 1926

	Ages								Totals
	Under 1	1	2	3	4	5	6–9	10 and over	
Susceptibles	44	56	67	63	62	83	233	67	612
Cases	15	33	45	43	42	60	207	28	493
Per cent of cases	34.1	59.0	67.1	68.3	67.7	72.3	88.8	71.6	80.5

It will be noted that the percentage of persons contracting the disease increases with age, reaching a maximum of 88.8 per cent in the 6 to 9 year age group. Above 10 years of age the percentage begins to decrease again. The smallest percentage of cases, 34.1, occurred among infants under 1 year of age, doubtless due to the usual immunity of infants during the first few months of life. This maternal protection is by no means certain, even in early infancy. A number of cases have occurred in children under 5 months of age, and we have already had one case of a 6 weeks' old baby. Of the infants 6 months of age or under, 13.3 per cent contracted the disease, while of those between 7 months and 1 year, 40 per cent came down with measles. The fact that susceptibles contract measles more

often in the older ages up to 10 is not necessarily due to any greater degree of susceptibility; it may be due to their larger acquaintanceship and therefore greater opportunity for more extended exposure.

About a year ago we called attention to the fact that, whereas it was often said that the ordinary communicable diseases were principally school diseases, in reality preschool children were affected to a far greater extent than school children. The figures presented at that time covered cases occurring during the year 1924. We offer the following table as substantiating the view that communicable diseases are primarily preschool diseases. The figures given cover a three-year period, including a total of over 40,000 cases.

Age distribution of cases of certain diseases occurring in Detroit during the past three years—1923, 1924, and 1925

Cases of—	Under 1	1 to 4	5 to 6	Total under 7	7 to 15	16 and over	Total
Measles	366	2,733	2,242	5,341	2,242	920	8,503
Lobar pneumonia	189	444	179	812	374	3,178	4,364
Broncho-pneumonia	825	1,003	199	2,027	266	924	3,217
Whooping cough	994	4,013	1,648	6,655	948	37	7,640
Scarlet fever	57	2,574	2,128	4,759	4,398	2,638	11,525
Diphtheria	129	1,598	979	2,706	1,632	1,650	5,988
Total	2,560	12,365	7,375	22,300	9,860	9,077	41,237
Per cent of cases of—							
Measles	4.30	32.14	26.37	62.81	26.37	10.82	100.00
Lobar pneumonia	4.33	10.17	4.10	18.61	8.57	72.82	99.99
Broncho-pneumonia	25.65	31.18	6.18	63.01	8.27	28.72	100.00
Whooping cough	13.01	52.53	21.57	87.11	12.41	.48	100.00
Scarlet fever	.49	22.33	18.46	41.29	38.16	20.55	99.99
Diphtheria	2.15	26.69	16.35	45.19	27.25	27.56	100.00
Total	6.21	29.99	17.88	54.08	23.91	22.01	100.00
Total minus lobar pneumonia	2,371	11,921	7,196	21,488	9,486	5,899	36,873
Per cent	6.43	32.33	19.52	58.28	25.73	15.99	100.00
Per cent of total population	1.91	8.43	4.03	14.37	15.47	70.16	100.00
Actual population	23,703	104,764	50,066	178,533	192,085	871,426	[1] 1,242,044

[1] As of May 31, 1925, official census.

Average annual attack rates by age groups during the three-year period—Cases per 1,000 living in each specified group in the average year [1]

	Under 1		1 to 4		5 to 6		Total under 7		7 to 15		16 and over		Total	
	Cases	Rate per 100,000	Cases	Rate per 100,000	Cases	Rate per 100,000	Cases	Rate per 100,000	Cases	Rate per 100,000	Cases	Rate per 100,000	Cases	Rate per 100,000
Measles	122	515	911	870	747	1,492	1,780	997	747	389	307	35	2,834	228
Lobar pneumonia	63	266	148	141	60	120	271	152	125	65	1,059	122	1,455	117
Broncho-pneumonia	275	1,160	334	319	66	132	676	379	89	46	308	35	1,072	86
Whooping cough	331	1,396	1,338	1,277	549	1,097	2,218	1,242	316	165	12	2	2,547	205
Scarlet fever	19	80	858	819	709	1,416	1,586	888	1,466	763	879	101	3,842	309
Diphtheria	43	181	533	509	326	651	902	505	544	283	550	63	1,996	161
Total	853	3,599	4,122	3,935	2,458	4,910	7,433	4,163	3,287	1,711	3,026	347	13,746	1,107
Population	23,703		104,764		50,066		178,533		192,085		871,426		1,242,044	

[1] This table derived from the above figures and inserted by the editor, Division of Preventive Medicine.

Although the legal school age is 7 in Michigan, it is not fair to assume that all children under 7 years of age are preschool children, for many of the 5 and 6 year olds are in school and obviously some cases of disease occur among them. As a matter of fact 54 per cent are in school.

As actually enumerated in the official census for 1925 the preschool population totals 151,488, or 12.20 per cent of the total population. The school population under 16 years of age totals 213,427, or 17.18 per cent of the total. Assuming that 50 per cent of the cases of disease, not counting lobar pneumonia which is essentially an adult disease, occurring among the 5 and 6 year olds are school children, we have a total of 17,890 cases among preschool children, or 48.52 per cent of the total number of cases for all ages. Since the preschool population represents but 12 per cent of the total this means that disease is four times more prevalent among this group than we would expect it to be. Among the school children under 16 a total of 13,084 cases of disease occurred, or 35.48 per cent of the total. Disease in the school group was therefore slightly more than twice as prevalent as it should be on the basis of population. Since the common communicable diseases are twice as prevalent among the school group and four times as prevalent among the preschool group as we should expect to find them on the basis of population, we have the right to conclude that *the incidence of disease is twice as high in the preschool group as in the school group.*

Particularly prevalent among preschool children are whooping cough, broncho-pneumonia, and measles. Scarlet fever seems to be the only disease which has as high an incidence among school children as it does in the preschool group although diphtheria closely approaches it.

When we consider the deaths from these same diseases the difference is even more striking. The following table gives the deaths by age groups for certain diseases in Detroit from 1923 to 1925, inclusive. If we deduct lobar pneumonia, which is essentially an adult disease, we find that the percentage of deaths under 7 years of age of the total deaths ranges from 68.95 for scarlet fever to 99.12 for whooping cough. The total under 7 for all the deaths listed, except lobar pneumonia, is 73.92 per cent as compared with 58.2 for the cases.

Deaths from certain communicable diseases in Detroit from 1923–1925, inclusive

	Under 1	1 to 4	5 to 6	Total under 7	7 to 15	16 and over	Total
Deaths from—							
Measles	51	89	6	146	4	6	156
Lobar pneumonia	269	181	37	487	69	2,531	3,087
Broncho-pneumonia	930	413	24	1,367	39	550	1,956
Whooping cough	129	93	3	225	0	2	227
Scarlet fever	6	99	26	131	22	37	190
Diphtheria	38	244	77	359	87	39	485
Total	1,423	1,119	173	2,715	221	3,165	6,101
Total, minus lobar pneumonia	1,154	938	136	2,228	152	634	3,014
Per cent of deaths from—							
Measles	32.69	57.05	3.84	93.59	2.56	3.84	99.99
Lobar pneumonia	8.71	5.86	1.20	15.78	2.23	81.99	100.0
Broncho-pneumonia	47.55	21.11	1.23	69.89	1.99	28.12	100.0
Whooping cough	56.83	40.97	1.32	99.12	0	.88	100.0
Scarlet fever	3.16	52.11	13.68	68.95	11.58	9.47	100.0
Diphtheria	7.84	50.31	15.88	74.03	17.93	8.04	100.0
Total	23.32	18.34	2.84	44.50	3.62	51.88	100.0
Total, minus lobar pneumonia	38.31	31.11	4.50	73.92	5.04	21.04	100.0

Average annual death rates by age groups during the three-year period—Deaths per 1,000 living in each specified group in the average year [1]

	Under 1		1 to 4		5 to 6		Total under 7		7 to 15		16 and over		Total	
	Deaths	Rate per 100,000	Deaths	Rate per 100,000	Deaths	Rate per 100,000	Deaths	Rate per 100,000	Deaths	Rate per 100,000	Deaths	Rate per 100,000	Deaths	Rate per 100,000
Measles	17	72	90	86	2	4	49	27	1	1	2	.2	52	4
Lobar pneumonia	90	380	60	57	12	24	162	91	23	12	844	97	1,029	83
Broncho-pneumonia	310	1,308	138	132	8	16	456	255	13	7	183	21	652	52
Whooping cough	43	181	31	30	1	2	75	42	0	0	1	.1	76	6
Scarlet fever	2	8	33	31	9	18	44	25	7	4	12	1	63	5
Diphtheria	13	55	81	77	26	52	120	67	29	15	13	2	162	13
Total	474	2,000	372	355	58	116	905	507	74	39	1,055	121	2,034	164
Population	23,703		104,764		50,066		178,533		192,085		871,426		1,242,044	

[1] This table derived from the above figures and inserted by the editor, Division of Preventive Medicine.

If we assume, as we did in the case of the incidence of disease, that one-half of the 5 and 6 year olds were preschool children and the other half school children, we find that a total of 71.66 per cent of the deaths (excepting lobar pneumonia) occurred among preschool children as compared with 7.3 per cent in the school group. In other words the ordinary communicable diseases kill almost ten times as many preschool as school children. On the basis of case fatality rates we find that 12.07 per cent of the preschool cases die while only 1.68 per cent of the school cases die. These diseases are there-

fore more than seven times as dangerous to preschool children as they are to school children.

Many, if not most, of these deaths are preventable. Their number may be very greatly reduced by—

1. Immunization against those diseases for which there is a definite prophylactic measure.
2. Avoiding unnecessarily exposing children, most especially the baby and preschool child, to cases or suspicious cases of communicable disease, particularly measles and whooping cough.
3. Calling a physician early.
4. Following the physician's advice very carefully.
5. Paying particular attention to the care of children convalescing from some communicable disease, most especially whooping cough and measles.

IMPORTANCE OF ADMINISTERING ANTITOXINS AT THE EARLIEST POSSIBLE MOMENT IN DIPHTHERIA

Health departments continue to find it necessary to prosecute an educational campaign among physicians with the hope that antitoxin will more often be used early in diphtheria cases and that the initial dose will be as large as circumstances require. The health department of New York City is no exception, in spite of the clinical and educational advantages available to physicians there and the vast amount of work that has been done in New York in developing both curative and preventive measures.

The following communication submitted by Dr. William H. Park, Director of the Bureau of Laboratories, known all over the world by his contributions to knowledge of diphtheria, was published December 10, 1925, by the department of health, City of New York, in its weekly bulletin:

Diphtheria antitoxin has now been in use for 30 years and it would seem that the last word had long ago been said upon the methods of using it for immunization and treatment, but unfortunately, we all forget many things that we learn and also miss many things in the literature.

The essential thing in the treatment of diphtheria with antitoxin is that it should be given at the earliest possible moment. If an animal is given intravenously ten fatal doses of diphtheria toxin, a few units of antitoxin, if given within five minutes, will save its life. At the end of half an hour, a thousand units will be needed and, at the end of two hours, no amount of antitoxin will save it. Fortunately, diphtheria begins as a local lesion and the toxin is absorbed by the adjacent tissue cells and there first produces inflammation. In acting on the cells, the toxin itself is used up and it is only when the disease progresses and the local tissues no longer can combine the toxin that it enters the lymph channels, passes to the blood and penetrates throughout the body. The amount of toxin in any case of diphtheria is comparatively small. One hundred units of antitoxin will neutralize the toxin

in any case of diphtheria. The difficulty is to bring the toxin and antitoxin quickly together. This requires large amounts of antitoxin.

Antitoxin is administered generally by two different methods—first, intramuscular and, second, intravenous. In a mild case, the intramuscular injection will save life as surely as the intravenous injection, but the good results will not be as quick. It requires at least 24 hours for two-thirds of the antitoxin to be absorbed from the muscle and enter the circulation. This time is saved by intravenous injection. The only objection to the intravenous injection outside of the difficulty of giving it is the occasional chill produced and, very rarely, symptoms of shock. If the serum is administered very slowly, the danger of shock is very slight indeed. The rule is to give intravenous injections in serious cases where the slight danger of shock is greatly overbalanced by the saving of life by giving antitoxin intravenously in bad cases.

The necessity of giving antitoxin early to get its beneficial effects leads to the advice that it should be given in all duobtful cases in children without waiting for the result of cultures. This means, naturally, that many cases will be given antitoxin that do not require it, but the annoyance is so slight that the greater good accomplished by its prompt administration in true cases more than makes up for the annoyance of giving it unnecessarily. In earlier times, repeated doses of antitoxin were given, but now, when it is realized that the antitoxin remains in the blood for a number of days, it is the almost universal custom to give a sufficient amount of antitoxin at the earliest possible moment and then not to give a second dose. Of course, if on seeing the case, a person did not have a sufficient amount of antitoxin, he would give what he had and then obtain more and give a sufficient amount. This would not be giving two doses intentionally, but simply giving the right amount in two injections made as early together as possible. As to the dose, it is certainly true that in mild cases two or three thousand units of antitoxin will suffice to save the life of any child. The difficulty is to be sure that the case is mild and that the poison has not developed beyond the amount suspected. The safe custom, therefore, is to consider every case as possibly severe and to give a sufficient dose to rapidly neutralize all possible toxin in the body. The dose of antitoxin has been decided partly by experiment in animals and partly by noting the results in human cases. As there is little difference in the rashes and the possibility of serum sickness between large and small doses, it is right to give as large a dose as one thinks there is any necessity for. The doses advised by the department are a minimum of 5,000 units and a maximum of 25,000 units. In all severe cases, the intravenous injections are advocated. If intramuscular injections are given in severe and toxic cases, the size of the dose should be doubled. Some excellent physicians have advocated very much larger doses, even as high as two or three hundred thousand units. There is no reason to believe that these enormous doses do any more good than moderate doses. In fact, a dose of 20,000 units is really an enormous dose, being fully two hundred times as much as would be required to neutralize the toxin in any case.

The study of cases by the social-service nurses of the department of health hospitals and by the physicians and nurses of the bureau of communicable diseases clearly shows that most of the fatal results come from the neglect to give antitoxin early. In about half the cases the delay is due to the patient not coming early to the observation of the physicians, but in nearly one-half the delay is due to the physicians procrastinating either because they are not sure of the diagnosis or because they have no antitoxin on hand.

Diphtheria antitoxin is a very stable fluid and can be kept in the office for several months without any considerable loss of units. At the end of three months, kept at the temperature of the office, there will be fully 80 per cent of the units remaining and the quality will remain unchanged. Every physician should have a dose at hand, so that there may not be any delay.

Owing to the general educational work of the last five years and the use of toxin-antitoxin, the diphtheria mortality has been cut in half. For the past two years, however, the mortality and the morbidity have remained about the same, and it is only by vigorous action in educating the people and the physicians of the city as to the necessity of immunizing young children with toxin-antitoxin that this remaining mortality can be greatly reduced. It will be a long time before all children have been protected by the toxin-antitoxin injections and, until this time, we must depend upon the early administration of antitoxin for the cure of those that are sick and for the protection of those that are in immediate contact with cases.

SYPHILIS A MENACE TO RAILROADS

The United States Public Health Service has recently issued the following as health news which should be accorded publicity:

> Syphilis to-day is preeminently the greatest menace attacking the man power of the American railroads.

This statement was made by Dr. J. R. Garner at the nineteenth annual meeting of the Southern States Association of Railway Surgeons.

Doctor Garner rejects the opinion which seems to be prevalent among the laity and also among members of the medical profession that railroad employees are more generally affected with syphilis than other occupational groups. He said, in touching this point:

> The railroad man is no more frequently infected with this disease than the general public, as will be shown statistically. However, it must be admitted that there is no class of men in whom the ravages of this disease play so great a part in disqualifying them for the duties of their occupation as it does those engaged in that most important branch of railroad work, train service. This, because every day thousands of human lives are intrusted to their care; millions of dollars of property pass through their hands, and the lives and limbs of their co-workers are either protected or jeopardized in direct proportion as their power is unimpaired. We are compelled to admit that a disease with so far-reaching devastations and such subtle and oftimes sudden manifestations of ravages, must be considered of great moment when encountered in this class of men.

A distinction is made between various stages of syphilis and their importance to railroads and their operation. Neglected or improperly treated syphilis usually runs through three stages—primary, secondary, and tertiary. It is the tertiary stage which is of chief concern, as in this stage syphilitic infection attacks the brain, causing mental lapses and even insanity.

The United States Public Health Service, in a recent publication dealing with this subject, states that the officials of a certain rail-

road were baffled in their search for the cause of four recent accidents. After every possible alternative cause had been considered it was found that in each case the person responsible suffered from the type of brain syphilis known as paresis.

Doctor Garner in his address stated that many lives have been lost, much pain and suffering occasioned, and great financial loss sustained in the past on account of just such cases of mental lapses due to syphilis on the part of employees who years ago had a syphilitic infection and who in the meanwhile had risen to positions of responsibility. He stated that if it were consistent he could present reports of many cases of accidents that have been traced to a possible syphilitic infection as at least a contributing cause; that records of cases could be shown where men with an impending catastrophe due to syphilis have been apprehended in time to avert it by keeping the patient under proper medical care. The paper closes with this statement, which is in the nature both of a challenge and appeal to those accountable for the physical well-being of railroad employees and in turn the patrons of railroad systems throughout the country:

> Because of its great importance and because the matter has not yet received anything like the attention that it deserves, this subject is presented to the railroad surgeons. We are in a position to prevent many catastrophes if we will only keep the matter before us whenever we examine an applicant for employment or when called upon to treat an injured employee. * * * It is firmly believed that with the cooperation of the local surgeons and company oculists, fully 45 or 50 per cent of syphilitic employees may be detected by simple inspection of eyes, gait, tremor, reflexes, etc., before the case has progressed too far.

For a number of years the United States Public Health Service and the State boards of health have been cooperating with railroad authorities and labor organizations in an effort to establish a sustained far-reaching program for venereal disease control among railroad employees. These organizations have long recognized the danger to the traveling public, as well as to the individual, of a person holding a position of responsibility such as a locomotive engineer, or switchman, or even flagman, being subject to mental attacks induced by latent syphilitic infection.

It is hoped that out of this effort will grow a permanent program which will insure high personal efficiency and public safety which will result from the reduction and control of the veneral diseases.

MOSQUITOES OBSERVED IN FLIGHT SEVERAL MILES OFFSHORE

The following interesting note relating to conditions under which mosquitoes may be borne seaward even in the absence of an off-shore

breeze was included by the commanding officer of the United States Naval Hospital, Pensacola, Fla., in his annual sanitary report:

Mosquitoes were very bad all along the Gulf this year and Pensacola had its proportion. The season was unusually dry and there were relatively few breeding places in the hospital compound in consequence, but larvæ were found in barrels, cans, and other receptacles in the vicinity of the hospital grounds. There were 17 cases of malaria admitted to the hospital; some of these were cases received from other stations. Several cases occurred in Warrington, and one developed in an officer's family living in the hospital grounds. This last case was certainly infected in the reservation. Very few anopheles were identified though careful search was made.

Fort Pickens on Santa Rosa Island to the south, a bad breeding place, is located one mile across the bay. The prevailing day breeze is from the south or southwest and comparatively few mosquitoes are in evidence along the shore. Upon one occasion a perfect cloud of mosquitoes passed from the Pickens shore to Fort McRae, just under 1 mile distant to the west. The wind at the time was moderate from the east. A vessel arrived here that had been fishing off the Mexican coast, and reported running into a cloud of mosquitoes approximately 150 miles off shore.

While fishing off East Pass (the upper end of Santa Rosa Island) and between 2 and 3 miles off shore, a considerable number of mosquitos appeared, probably 50 being killed. We were trolling parallel to the shore at the time. As we returned the same thing occurred. I then noticed a repetition of this each time we crossed a tide rip marked by a considerable amount of foam. The waters from Choctawhatchee Bay discharging into the Gulf caused the tide rip. The mosquitoes were undoubtedly being carried out to sea with foam, as the very slight breeze was not favorable for their being blown to sea and the whole night had been practically a flat calm. I did not investigate to see how much farther off shore the mosquitoes could be found, but the tide rip extended some 2 or 3 miles farther into the Gulf at least.

PSYCHROMETERS FURNISHED SHIPS BY BUREAU OF NAVIGATION

A number of the reports required in connection with full-power trials of naval vessels, including some recently submitted, have contained a statement to the effect that the medical officer was unable to include relative humidity or wet-bulb thermometer readings taken in the engine room and fireroom during the trial because a sling psychrometer was not available.

The matter was taken up with the Assistant Chief, Bureau of Engineering, and he stated that the Bureau of Navigation supplies two psychrometers to each battleship or other capital ship and one to each small ship. It is considered that these are available for use by medical officers in collecting the data required by the questionnaire relating to atmospheric temperature, relative humidity, air movement, and physical efficiency of the personnel in firerooms and engine rooms during engineering trials and full-power runs.

In cases where the dry-bulb temperature is very high a relative humidity table showing values for temperatures as high as the observed temperature may not be available. In such instances the wet-bulb and dry-bulb readings as observed will suffice. The percentage of water vapor present will be calculated in the bureau. But, when practicable, the calculations should be made on board ship because the necessity of completing any considerable proportion of the reports by inserting the relative humidity values would consume more time than should be devoted to the study of these reports in view of the mass of statistical work and the number of reports of different character that must be handled by a small office force.

REGARDING STATISTICAL PRACTICE AND PREPARATION OF FORM F CARDS

CONDITIONS EXISTING PRIOR TO ENTRY INTO THE NAVAL SERVICE—STATISTICAL PROCEDURE IN REPORTING

There seems to be uncertainty in the minds of many medical officers as to the procedure for admitting patients for disabilities that evidently existed prior to entry into the naval service.

The instructions contained in the Bureau of Medicine and Surgery Circular Letter 348—1924, direct that all cases admitted to the sick list for disabilities existing prior to entry into the naval service shall be taken up as *readmissions* (RA). This is done in order to avoid including these cases in the sickness rates of the Navy. This is for statistical purposes only, and there should be no confusion with the question whether in view of legal opinions and decisions the disability is to be considered as having occurred in the line of duty or not in the line of duty.

Officers returning from sick leave should be readmitted to the sick list and Form F card should be forwarded to the bureau.

It often happens that officers reporting in for examination upon the expiration of sick leave are not readmitted and entries are not made in the health record in accordance with the provisions of

paragraph 2289 (b) of the Manual of the Medical Department. A note is sometimes made in the health record but no Form F card is forwarded to the bureau.

Officers on the sick list are transferred to sick leave and the case must finally be disposed of upon the expiration of sick leave; therefore, it should be regularly taken up as readmission (RA) from sick leave, when the officer reports in at the expiration of his leave, and he should be discharged to duty. A Form F card should be forwarded to the bureau, so that records may be completed.

STATISTICS RELATIVE TO MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

The following tables were constructed with figures taken from monthly reports submitted by boards of review at naval training stations:

Cumulative data for January 1 to December 31, 1925

	Number	Per cent of recruits received	Per cent of recruits reviewed
All naval training stations:			
Recruits received during the period	9,385		
Recruits appearing before board of review	688	7.33	
Recruits recommended for inaptitude discharge	465	4.95	67.59
JANUARY, FEBRUARY, MARCH, 1926			
U. S. Naval Training Station, Hampton Roads, Va.:			
Recruits received during the month	684		
Recruits appearing before board of review	24	3.51	
Recruits recommended for inaptitude discharge	24	3.51	100.00
U. S. Naval Training Station, Great Lakes, Ill.:			
Recruits received during the month	835		
Recruits appearing before board of review	74	8.86	
Recruits recommended for inaptitude discharge	38	4.55	51.35
U. S. Naval Training Station, San Diego, Calif.:			
Recruits received during the month	1,196		
Recruits appearing before board of review	84	7.02	
Recruits recommended for inaptitude discharge	54	4.52	64.29
U. S. Naval Training Station, Newport, R. I.:			
Recruits received during the month	742		
Recruits appearing before board of review	80	10.78	
Recruits recommended for inaptitude discharge	17	2.29	21.25

ADMISSIONS FOR INJURIES AND POISONING, FIRST QUARTER, 1926

The following table, indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during the first quarter, 1926, is based upon all Form F cards covering admissions in those months which have reached the bureau:

	Admissions, January, February, and March, 1926	Admission rate per 100,000 per annum	Admission rate per 100,000, year 1925
INJURIES			
Connected with work or drill	774	2,715	3,343
Occurring within command, but not associated with work	486	1,705	2,001
Incurred on leave or liberty or while absent without leave	236	828	1,049
All injuries	1,496	5,248	6,393
POISONING			
Industrial poisoning	5	17	25
Occurring within command, but not connected with work	7	25	490
Associated with leave, liberty, or absence without leave	6	21	16
Poisoning, all forms	18	63	531
Total injuries and poisoning	1,514	5,311	6,924

Percentage relationships

	Occurring within command				Occurring outside command	
	Connected with the performance of work, drill, etc.		Not connected with work or prescribed duty		Leave, liberty, or a. w. o. l.	
	January, February, and March, 1926	Year, 1925	January, February, and March, 1926	Year, 1925	January, February, and March, 1926	Year, 1925
Per cent of all injuries	51.7	52.3	32.5	31.3	15.8	16.4
Per cent of poisonings	27.8	4.7	38.9	92.2	33.3	3.1
Per cent of total admissions, injury and poisoning titles	51.4	48.6	32.6	36.0	16.0	15.4

Poisoning by a narcotic drug or by ethly alcohol is recorded under the title "Drug addiction," or "Alcoholism," as the case may be. Such cases are not included in the above figures.

During the quarter covered by the above statistics there were only four cases worthy of special notice from the standpoint of accident prevention. These will be described in a subsequent report along with any others that may occur.

HEALTH OF THE NAVY

Statistical returns for the first quarter of 1926 gave a low general admission rate; 546 per 1,000, as compared with an expected rate of about 700 for the winter months. The admission rate for accidental injuries ran a little lower than usual, 52 per 1,000.

Influenza and catarrhal fever were quite prevalent in some commands in February and March, but comparatively few admissions resulted from these causes in April.

More cases of cerebrospinal fever than usual occurred in the Navy during the winter and spring months. In January there were 9 cases at the naval training station, San Diego, Calif.; in February, 5 at the United States naval training station, Great Lakes, Ill.; and 1 on board the U. S. S. *Pennsylvania*. In March, 9 cases occurred at the Great Lakes station; 1 on board the U. S. S. *Langley;* and 1 at the United States naval training station, San Diego, Calif. One more case occurred at the Great Lakes station in April.

The measles situation in the country at large during the spring months was such that outbreaks in the Navy were anticipated, but comparatively little increase in prevalence has been reported. Only 4 cases were notified by ships in April, and 58 by shore stations in the United States. So far as experience with this disease in the Navy is concerned it is improbable that any considerable increase in prevalence will occur during the summer months, but it is not unlikely that more cases will occur in the early months of 1927 than during the past winter.

TABLE No. 1.—*Summary of morbidity in the United States Navy and Marine Corps for the quarter ended March 31, 1926*

	Forces afloat	Forces ashore	Marine Corps	Entire Navy
Average strength	75, 462	38, 570	19, 731	114, 032
All causes:				
Number of admissions	7, 910	7, 658	3, 369	15, 568
Annual rate per 1,000	419. 28	794. 20	682. 99	546. 09
Disease only:				
Number of admissions	7, 044	7, 010	3, 047	14, 054
Annual rate per 1,000	373. 38	726. 99	617. 71	492. 98
Communicable diseases, exclusive of venereal disease:				
Number of admissions	2, 220	4, 110	1, 744	6, 330
Annual rate per 1,000	117. 68	426. 24	353. 55	222. 04
Venereal diseases:				
Number of admissions	2, 609	657	398	3, 266
Annual rate per 1,000	138. 29	68. 14	80. 68	114. 56
Injuries:				
Number of admissions	855	641	318	1, 496
Annual rate per 1,000	45. 32	66. 48	64. 47	52. 48
Poisoning:				
Number of admissions	11	7	4	18
Annual rate per 1,000	. 58	. 73	. 81	. 63

TABLE NO. 2.—*Deaths reported, entire Navy, during the quarter ended March 31, 1926*

Primary	Secondary or contributory	Navy: Officers	Navy: Midshipmen	Navy: Men	Marine Corps: Officers	Marine Corps: Men	Nurse Corps, nurses	Total
Average strength		8, 248	1, 755	83, 814	1, 158	18, 572	484	114, 031
CAUSES—DISEASES								
Abscess, peritonsillar	Hemorrhage			1				1
Appendicitis, acute	Peritonitis, acute general			3		2		5
Arteriosclerosis, general	Hemorrhage, cerebral					1		1
Do	Nephritis, chronic			1				1
Beriberi	Myocarditis, chronic			1				1
Bronchitis, acute	Pneumonia, broncho			1				1
Cerebrospinal fever	None			3				3
Do	Myocarditis, acute			1				1
Do	Pneumonia, broncho			1				1
Diabetes, mellitus	None			1				1
Focal infection (teeth)	Septicemia			1				1
Influenza	Pneumonia, lobar	1						1
Measles	Pneumonia, broncho					1		1
Meningitis, cerebrospinal	Pleurisy, suppurative			1				1
Nephritis, acute	None			1				1
Pneumonia, broncho	Pericarditis, acute					1		1
Pneumonia, lobar	None			1		2		3
Do	Abscess of lung			1				1
Do	Erysipelas			1				1
Pyelitis, acute	Septicemia			1				1
Septic sore throat	do					1		1
Staticus lymphaticus	None			1				1
Syphilis	Dementia, paralytica			1				1
Thyroiditis, acute	Pneumonia, broncho			1				1
Tonsillitis, acute	Septicemia			3				3
Tonsillitis, chronic	Pneumonia, broncho (following anaesthesia).			1				1
Tonsillitis, chronic (Op.)	Edema glottis					1		1
Tuberculosis, chronic pulmonary.	None			8				8
Ulcer, duodenum	Hemorrhage			1				1
Do	Pneumonia, broncho	1						1
Valvular heart disease combined lesions, aortic and mitral.	None	1						1
Malignant growths	do			1			1	2
Total for diseases		3		37		9	1	50
CAUSES—INJURIES AND POISONINGS								
Asphyxiation, illuminating gas.	None			3				3
Fracture, simple skull	do			1				1
Fracture, compound skull	do			2				2
Fracture, compound frontal bone and maxilla.	do			1				1
Intra-cranial injury	Hemorrhage			1				1
Injuries, multiple, extreme	None	1		3	1			5
Wound, punctured	do			3		3		6
Drowning	do			8				8
Poisoning, alcohol, ethyl	do					1		1
Poisoning, alcohol, methyl	do					2		2
Poisoning, carbon monoxide.	do			1				1
Poisoning, chloral, hydrate	do			1				1

TABLE No. 2.—*Deaths reported, entire Navy, during the quarter ended March 31, 1926*—Continued

		Navy			Marine Corps		Nurse Corps, nurses	Total
		Officers	Midshipmen	Men	Officers	Men		
CAUSES—INJURIES AND POISONINGS—continued								
Primary	Secondary or contributory							
Poisoning, cocaine, acute	None			1				1
Poisoning, sodium cyanide, acute.	do			1				1
Total for injuries and poisoning		1		26	1	6		34
Grand total		4		63	1	15	1	84
Annual death rate per 1,000, all causes		1.93		3.01	3.45	3.23	8.26	2.95
Annual death rate per 1,000, disease only		1.45		1.77		1.94	8.26	1.75
Annual death rate per 1,000, drowning				.38				.28
Annual death rate per 1,000, injuries		.48		.67	3.45	.86		.67
Annual death rate per 1,000, poisoning				.19		.43		.25

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U. S. NAVAL MEDICAL BULLETIN

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SPECIAL ARTICLES

MEDICAL TACTICS IN NAVAL WARFARE—Continued

By W. L. Mann, Lieutenant Commander, Medical Corps, United States Navy

PART II

TACTICAL EMPLOYMENT OF HOSPITAL FACILITIES IN NAVAL WARFARE

It may be advisable to reconsider briefly certain statements contained in Part One—Medical Tactics on Board Combatant Ships—which appeared in the April issue of this publication.

The comprehensive definition of naval medical tactics—i. e., the development and use of medical agencies in war at sea—as outlined in the first installment, permits this treatise to be a rather broad discussion and survey of the war-time functions of a naval medical department.

The primary purpose of the preparation of this discussion was also stated to be an attempt to assemble, sort, and arrange, within a convenient compass, the salient features of the mass of available data, in order to provide useful and helpful information for medical officers, afield and afloat, which may be utilized as a basis for formulating their individual plans for action. Because it has been shown that all the peace-time activities of a highly specialized military organization, however divergent these activities may seem at first appearance, when followed to their ultimate analyses finally converge to a common objective, namely, the maintenance of a state of readiness for war-time conditions.

A broad conception of the various highly differentiated functions of a modern naval medical service indicates that the functions of the medical officer on recruiting duty, in the laboratory, in the surgical operating theater, in the field, or in other various details of duty, converge toward this same objective. The aims of a naval medical department, grouped with the purposes of the other branches of the

naval service, form the peace-time mission of the naval service as a whole—to maintain a state of readiness for rapid conversion to war-time activities.

This view of the teamwork that each individual plays in the military game may serve to lighten some of the arduousness of our daily routine tasks by stimulating a more active interest in our chosen profession.

A few years ago, the greatest conflict—in which was fought the greatest naval engagement in the history of man—took place, which fact causes one to speculate whether the naval medical lessons derivable from an analytical study of this war have been fully appreciated.

The results of this study are not presented as a perfected or final preparation, but only as another link in the endless chain of development—with a view that some of the ideas in this assembly may subsequently be further elaborated or provoke discussion of debatable points.

The hospital facilities planned for the United States Navy include:

A. Hospital ships.
B. Navy base hospital units.
C. Station hospitals.
D. Existing naval hospitals.

SYNOPSIS OF PART TWO

Following the procedure adopted in the preceding installment, an outline of this section is placed at the beginning, in order that familiarity with the fundamentals may be obtained more readily.

TACTICS OF HOSPITAL SHIPS

Historical.—The military value of hospital ships as a means to relieve the warships of battle casualties was recognized over two centuries ago.

The extensive employment of such vessels in the World War has firmly established this medical unit as a military and naval necessity—considerably more than 100 of these vessels being used in that conflict.

Classification.—

I. For civilian patients

1. Floating hospitals for inhabitants of metropolitan areas.
2. For care of civilian maritime population.

II. For military patients

1. Fulfilling conventional requirements.
   - (*a*) Military.
     - Class A, or Fleet Hospital Ships.
     - Class B, or medical transports.
   - (*b*) Red Cross of belligerents.
   - (*c*) Red Cross of neutrals.
   - (*d*) Improvised hospital ships.
2. Not fulfilling conventional requirements.

Employment.—
1. Peace time—Instructional, and as floating hospitals.
2. War time—(*a*) Cruising—Class A ships with main body; class B proceed singly.
   - (*b*) Position of readiness.
     Class A to be as near scene of action as practicable, while
     Class B should be at greater distances.
   - (*c*) During Action.
     The majority of opinions oppose the attempted use of hospital ships during action; however, it is believed that the military advantage of employing certain hospital ships as rescue vessels warrants further trial and consideration.

Evacuation.—A well-organized system for debarkation and embarkation of patients is essential. Mechanical apparatus for hoisting patients, stretcher slings and bridles, ambulance boats, elevators between decks, etc., are contrivances necessary for prompt and rapid evacuation to and from hospital ships.

A separate organization has been found useful for the maintenance of contact between hospital ships and shore hospitals.

Requirements of a major naval power.—

	Ships
Class A	11
Class B	25
(10 to be rescue ships.)	
Total	36

TACTICS OF SHORE HOSPITALS

Naval base hospital.—Semimobile. portable institution, of 500 beds' capacity, designed to supply hospital facilities overseas at advanced base; tentage construction to be replaced by hutments.

Station hospital.—Emergency institution (100 beds' capacity) to function in parts of the country where the services of naval hospitals are not available. In some cases it may be utilized in lieu of the above type. Standard type of war-time construction, except when established overseas, then hutments used.

Naval hospital.—Existing institution capable of expansion. Fixed organization representing the rearmost supporting medical formation in naval warfare.

A. TACTICAL EMPLOYMENT OF HOSPITAL SHIPS

Evolution and Development of Hospital Ships

In this modern age of rapid progress it is difficult to limit accurately history to a definite sphere, because a device, procedure, or process is barely developed and placed in practical use before plans are drafted for radical innovations and improvements which relegate their prototypes to the realm of history. However, in an extensive consideration of modern practices, a historical review, if not carried too far into the realm of the ancient, will show the reasons for the existing conditions, the probable trend of future development, and what ideas have been considered and discarded by our predecessors. The early history of hospital ships is included in this treatise purely as a matter of historical interest.

The ancient Greeks are said to have used appropriate proper nouns to designate objects, and from this fact it is natural to infer that the trireme, called *Therapeia*, with the Athenian fleet (B. C. 431–401) was a prototype of the modern hospital ship. At least it would appear that she was a vessel fitted for the reception of the disabled and not a fighting craft.

With the Roman fleet off Micenum there was a ship named *Aesculapius*. Although there are no available records to show that she actually functioned as a hospital ship, yet it is known that the Romans had developed a distinct naval medical corps at this period and had military hospitals for land forces, which makes it appear reasonable to infer that the *Aesculapius* was utilized as a hospital for the forces afloat.

At the time of the Crusades the ship carrying the cardinal legate of Pope Honorius III to the Holy Land was fitted with complete hospital equipment for a large number of patients, which enabled this vessel to serve as a hospital transport. Marin Sanudo, in one of his books, begun in 1306, recommends that each flagship carry three surgeons and three physicians, and there are reasons to believe that it was an early naval custom to designate certain vessels, usually flagships carrying the fleet surgeon, as special ships for the care of the sick and wounded.

It would appear that Spain was the first of modern nations to foresee and utilize the tactical advantages of hospital ships with a naval fleet. In the Armada there were, according to the Spanish account of it (Archdeacon's translation, 1588) ," eighty-five physicians and surgeons for the hospital ships." (Quoted from Smart.)

It was some 35 years after the famous voyage of the Armada that a disastrous experience of England caused this nation to realize the military value of hospital ships. In 1626, after the British expedition had reembarked from the landing at Cadiz the fleet then cruised off St. Vincent, endeavoring to intercept treasure ships. "Where, having waited some time, the men began to grow very sickly; when, to compleat the miscarriage of the expedition, the sick men were distributed through the whole fleet, two to each ship, by which means the sickness was increased to such a degree that there were scarce hands enough to carry the fleet home." (Burchett.)

Two years later, 1628, a select committee on the state of the navy reported to Parliament that there was "not good provision for seamen, that they were *ill clothed, causing infection of ships.*"

It was probably incidents similar to the above that eventually determined the British Navy to use hospital ships as a means to segregate the sick from the well. Even in those days it required several years for the navy to apply the lessons derived from a military experience, as is demonstrated by the period of time elapsing before the actual employment of a hospital vessel. As early as 1608 the British employed an auxiliary ship—the *Goodwill*—in the Mediterranean for hospital purposes (Farenholt), yet one of the first definite allusions to hospital ships in the English Navy is the one to the hospital vessel accompanying the fleet of Admiral Penn, in the West Indies, in 1654, of which Dr. Paul Delaune was the physician.

In speaking of the British expedition to Santo Domingo in 1665, Dr. John Campbell in his "Naval History," volume 2, page 101, mentions a hospital ship: "Before the forces were embarked, Adjutant General Jackson was tried at a court-martial, and not only sentenced to be cashiered and his sword broken over his head, *but to do duty of a swabber, in keeping clean the hospital ship*—a punishment suitable to his notorious cowardice."

The French lay claim to having been the first modern nation to utilize a seagoing ship to accompany a naval fleet in action for hospital purposes. Toward the end of the seventeenth century, it was recommended that 100-bed hospital ships, devoted exclusively to the care of the sick and disabled, be attached to the French fleet in the proportion of 1 hospital ship to every 10 ships of the line. These hospital vessels were to be constructed with high decks and large

portholes and were to carry no batteries in order to provide more space for the wounded.

Several of the hospital ships accompanied the fleet which left the roadstead of Brest in June, 1690, to engage in the battle of Beachy Head. The hospital ships took positions with the cargo vessels on the right wing of the fleet—a tactical disposition which would, perhaps, be applicable to-day. According to the records, 60 wounded from hospital ships were disembarked on the northern coast and 81 on the western; which was a small percentage of the total patients present in the fleet—811 wounded and 712 sick (1).

It seems that some of the warships, in disobedience to orders, returned to home ports and made no attempts to transfer the sick to hospital ships; hence the value of such vessels for receiving the sick and wounded from the fleet at sea was not given a satisfactory test at this battle. Yet the need of seagoing hospital ships to disencumber the fighting ships of the disabled was demonstrated by the fact that the presence of the large number of sick and wounded aboard requiring medical attention was given as a reason for some of the vessels leaving the fleet, contrary to previous orders, and returning to port, thus defeating the very mission for which the hospital ships were intended.

It is probable, however, that the transfer of wounded in those days between sailing vessels at sea was difficult compared to the transshipment to-day with the assistance of motor boats and other mechanical contrivances.

The British Navy employed hospital ships about this time, as shown by the following records (Kealy) (2):

> In 1673, one William Draper, serving on board the *Royal Prince*, on falling sick two days before the action of August 11, was transferred to the hospital ship.
>
> Richard Allyn, chaplain of the *Centurion*, gives a list of vessels engaged in the battle of La Hogue, and lists two hospital ships attached to each squadron, the *Red* and *Blue*.
>
> In 1701, Sir George Rooke requested that the hospital ship bring a good supply of Thames water for the fleet.
>
> In 1718 a hospital ship accompanied the force of Sir George Byng when he sailed from Spithead on June 15.

At one time hospital ships were usually the captured vessels of the enemy, rather unserviceable for other purposes, and often served chiefly as places of isolation for contagious diseases—such as the yellow fever cases in the West Indies—and for the purpose of detention.

The ships used to bring home the wounded of an amphibious expedition were transport vessels which had carried the troops to the scene of battle, and the mere presence of the sick aboard was

the principal reason for designating them as hospital ships. "Corpses marked their course."

Sir Gilbert Blane records that Admiral Vernon—for whom Mount Vernon, the famous estate of Gen. George Washington on the Potomac was named—had two hospital ships available for his force in 1740–41 (Taylor—Nav. Med. Bull. 14:617). About this time Blane recommended the use of hospital ships to relieve the large percentage of sick in the West Indies.

Smollett, in chapter 33 of "Roderick Random," says that the force of 8,000 able men landed on the beach near Boca Chica about 1741 was reduced to 1,500 men.

"The sick and wounded were squeezed into certain vessels, which thence obtained the name of hospital ships, though methinks they scarce deserve such a creditable title, seeing few of them could boast of their surgeon, nurse, or cook; and the space between decks was so confined that the miserable patients had not room to sit upright in their beds. Their wounds and stumps being neglected, contracted filth and putrefaction, and millions of maggots were hatched amidst the corruption of their sores. This inhuman disregard was imputed to the scarcity of surgeons, though it is well known that every great ship in the fleet could have spared one at least for this duty; an expedient which would have been more than sufficient to remove this shocking inconvenience."

The *Nightingale*, a vessel of 522 tons, served as a British hospital ship about 1775. At that time hospital ships were stationed at each of the home naval bases and used in place of shore hospital establishments.

In 1781 the British used special ships for the inspection, detention, and outfitting of recruits before their distribution to the fleet, and these ships were designated "slop ships"—"slop" being a vernacular term used to include the bedding and clothing furnished recruits. Lind was an advocate of this use of slop ships for the reception and outfitting of recruits and to serve as a place for disinfection.

The following was taken from the official instructions of the British Navy, dated 1772:

Article I.

Ships appointed for Hospitals, shall have the Gun-Deck entirely set apart for the Reception of Sick Men, which shall be flush, without any Cabbins or Bulkheads, except a Deal or Canvas one (to roll up) for separating such as have malignant Distempers from the rest. The said Deck is to hold all the necessary Cradles, with the Bedding; and two Pair of chequer'd Linen Sheets shall be allowed for every Bed, and Scuttles shall be made in the Sides, in convenient Places, for Inlets of the Air.

II.

Besides the Physician, there shall be in the Hospital-Ship an able and experienced Surgeon, with four Mates, and six Men Assistants, a Servant to the Surgeon, a Baker, and four Washermen; all supernumerary to the Complement.

III.

The Captain of the Hospital-Ship shall subsist the Men under Cure, out of the best and newest Provisions in the Ship; and with fresh Meat as often as the same can be procured.

IV.

When any Men are well enough recovered to return to their Ship, the Captain of the Hospital-Ship shall put abroad their Ship's Signal and a Weft, that a Boat may be sent for them.

The Physician.

Article I.

The Physician is to embark and reside in the Hospital-Ship, if there be any, or in such other Ship as the Commander in Chief shall appoint.

II.

He is to visit the Ships of the Squadron or Division he belongs to, as often as the Curcumstances of the Sick and Hurt Men in them shall make it needful, taking the Surgeon of the Ship with him in his Visitation, and prescribing to him the Remedies to be applied for their Cure.

III.

He is impowered at any Time, with the Approbation of the Admiral or Commander in Chief, to go on Board any Ship of the Squadron or Division he belongs to, and inspect into the Chest of the Surgeon, examining the Goodness of his Instruments, Drugs, and other Medicaments, and to destroy such as are unfit for Use. He may call for his Journal, and enquire into his Method of Practice, and represent his Failures, whether through Ignorance or Negligence, to the Commander in Chief.

IV.

He is to observe all such Orders and Directions as he shall receive from the Admiral or Commander in Chief, relating to the Service; and to demand no Fee or Reward from any Person under his Care.

Cookes-Willyams, of the *Boyne*, in his account of the campaign in the West Indies, in which the army acted with the fleet, says that after the Grenadiers had repulsed an attack in the Isle of Martinique the wounded were transferred to the *Roebuck*, the hospital ship of the fleet. The hospital ship *Dolphin* was with Hood at Toulon in 1793.

A hospital ship, the *Charon*, was attached to Lord Howe's fleet off Ushant in 1794, and about this time one was attached to Lord Bridge-

port's fleet off Belle Isle. Trotter was fleet surgeon, joining the *Charon* in April, 1794, and, writing about 1800, he says, "But I received no instructions that an hospital ship should be fitted which had before bestowed such unspeakable comforts to the sick berth."

In his journals he says: "On September 30, 1795. This day Earl Spencer, accompanied by Lord H. Seymour and Mr. Pybus, Lords of the Admiralty, honored the *Charon* hospital ship with a visit."

In another place we read of the hospital ship *Pharon* with Howe in 1794 during the battle of June 1. Whether these two similar names refer to the same or separate hospital ships has not been ascertainable.

The *Medusa*, a 50-gun ship, was fitted out about this time at Plymouth as a hospital ship.

A red, white, and blue pennant flown at the mizzen topmast head was the signal used in 1796 to denote that the sick could be transferred to "an hospital ship."

The following official instruction promulgated in 1805 by the British Navy shows the special ships employed in those days: "Surgeons of receiving ships, slop ships, convalescent ships, prison ships, and all other ships, except hospital ships, employed only in harbour duty, shall be allowed full pay, 10s. per day, with half pay according to the time of their service." Convalescent ships were often used as auxiliaries for hospital ships.

The *Dreadnought* served as a hospital ship from 1821 to 1870 for the seamen of the merchant service.

The British "Order in Council of the 23d January, 1805, for improving the situation of the medical officers of the navy, as relates to such officers serving on board ships," provides that three assistants, "heretofore called Surgeon-Mates," be allowed each hospital ship.

During the period following the Napoleonic wars to the beginning of the Crimean campaign there is little evidence to show the employment of hospital ships (Sutton), and the real history of the modern hospital ship begins about the middle of the nineteenth century (Zur Verth). During the Crimean War in 1854 England employed a fleet of transports to convey home the sick and wounded. In 22 months over 100,000 patients were transferred home (Holcomb).

The British equipped two ironclad steamships—the first of this type of vessel to serve as hospital ships—for use in the China operation of 1858. Shortly after this, several ships were used in the American Civil War as hospital ships, as will be described later.

Bell states that the French are said to have built the *Annamite* as a hospital ship in 1877, and others of the class later, and if so,

that nation can claim credit for the first vessel designed and constructed for hospital purposes.

The Italians possessed the hospital ship *Washington* in 1866, but it appears that no hospital vessel was present at the Battle of Lissa, on June 27, 1866, where the Italians lost 600 men from drowning and only 15 from gunfire. This battle occurred before the days of the application of The Hague Convention to maritime warfare, and this hospital ship was armed. The *Washington* was commanded by Medical Inspector Giovanitti, of the Italian Navy.

In the war of 1880 between Peru and Chile the Red Cross Society of Lima organized a hospital ship and requested permission of the admiral of the Chilean forces, blockading Callao, to insure safe passage through the lines. This authority was granted and the ship was permitted to return the sick and wounded to the home country. (Bulletin International, No. 44, October, 1880, p. 172, quoted from Barbier.)

H. M. S. *Victor Emanuel* and H. M. S. *Simoon* were converted into hospital ships for use off the West Coast of Africa, and in 1885 the P. & O. Co.'s steamship *Ganges* was converted into a hospital ship to serve with the Suakin expeditionary force. The former vessel required 2 months while the latter required only 12 days for conversion to hospital purposes.

Ten years later one of the first purely naval hospital ships was equipped by the Japanese and utilized in the war with China (1894–95). The equipment of this vessel was unusually complete for that period.

Shortly afterwards the British employed the *Coromandel* and *Malacca* for the use of the expeditions to west Africa.

There were six hospital ships employed by the American forces engaged in the Spanish-American War. These are listed elsewhere.

In the South African War (1899–1901) over 70,000 wounded were transported to British home ports by means of 10 hospital ships; 4 of these were fitted out in England and 6 were equipped in South Africa.

The Atlantic Transport Co., which during the Spanish-American War had given the hospital ship *Missouri* to the American Government, gave the twin ship to this, the *Maine*, to the British Government for use in this war. This vessel was fitted out by a group of American women residing in London and continued in service until June 29, 1914, when she was wrecked by going ashore in a thick fog. The *Panama* was fitted out as a hospital ship and renamed the *Maine* on March 26, 1921. (S. 1503/21—26/3/1921.)

The following vessels were employed in the Russo-Japanese War as hospital ships:

Saiko Maru	Japanese naval hospital ship.
Kobe Maru	Do.
Hakuai Maru	Japanese Red Cross hospital ship.
Kosaki Maru	Do.
Kanzan	Russian naval hospital ship.
Angara	Do.
Mongolia	Russian Red Cross hospital ship.
Orel	Do.
Kostroma	Do.

The Japanese Army utilized 18 hospital ships during this war.

The first three mentioned Russian vessels served with the Port Arthur squadron, primarily as stationary hospitals, while the *Orel* and *Kostroma* accompanied the force of Admiral Rojestvensky. All five of the Russian hospital ships fell into the hands of the Japanese.

In the war with Turkey (1911) the Italians used the following hospital ships: *Re d'Itali*, *Regina d'Italia*, *Memfi*, and *Regina Margharita*. The first-named vessel was converted into a hospital ship, perfectly prepared and satisfactorily equipped, within seven days. Rosate states that if necessity had demanded it the vessel could have been prepared for its mission within 48 hours.

Before the World War hospital vessels were operated more as medical transports than as class A hospital ships. Marmion says, "In no sense is the *Solace* to be considered as a hospital ship when serving in the Spanish-American War. When a second action is impending, this vessel must deliver the sick and wounded to the nearest hospital for treatment and then rejoin the fleet. Should the American Army invade Cuba it will probably fall to her lot to transfer the wounded to Key West. Thus this ship is more properly designated as 'ambulance ship.'"

In the Russo-Japanese War, due to the proximity of shore hospitals, some of the hospital ships of the Japanese were fitted for the care of wounded for a period of only three days, and thus served more as medical transports than as floating hospitals.

The experience gained by the British in bringing home the disabled from South Africa during the Boer War apparently is partially accountable for the excellent hospital ship service instituted during the World War.

Hospital ships returned the physically incapacitated to Australia and New Zealand while other hospital vessels evacuated the wounded from India, Mesopotamia, Egypt, the Dardanelles, Salonica, France, and South Africa.

At the beginning of the recent war England had no hospital ships in commission—the *Maine* having been wrecked a few weeks previously—yet within four days of mobilization orders three ocean

liners were converted into hospital carriers. "Their medical supplies and equipment had been already procured and stored at one of the large medical depots; six others were ready inside of three weeks or less."

Four hospital ships—*St. Patrick*, *St. Andrew*, *St. David*, and *Asturias*—cleared 3,387 sick and wounded from Havre and other ports to Southampton between the 26th of August and the 3d of September, 1914.

In the Great War of 1914–1918 the British employed 21 naval and 84 military hospital ships. In 1914, 40 ships were notified by this nation as hospital ships, and in 1915, 59 more ships were converted into hospital vessels (German note of January 28, 1917).

The *Gera*, *Wittekind*, and the *Savora* were used by Germany as hospital ships before the World War. The first-named ship was reconstructed in 1900. At the outbreak of war the German Navy commissioned 7 hospital ships and 10 ambulance ships. The class A hospital ships required about 10 days to convert, while the auxiliary ships were ready in from 2 to 5 days.

The Germans designated their hospital vessels by a letter of the alphabet, as "Hospital Ship D," and the assigned letter was painted at the bow of each of these ships.

The Austrian Red Cross Society early in 1914 equipped three vessels of the Austrian Lloyd—*Elecktra*, *Metkovitch*, and *Tyrol*—as hospital ships. These were used in the campaign against Serbia.

In the Mediterranean alone over 220,000 sick and wounded were safely transported in French hospital ships operating under the Red Cross flag and under the protection of the Hague convention (Chevalier) (3).

Eight hospital ships under the French flag evacuated the sick and wounded from Salonica to Bizerta and Toulon. Morton remarks that the excellent organization aboard French hospital ships enabled them to conduct their hospital with less than one-half the medical force required by other nations (4).

The services rendered the army of the northern front by French hospital ships during early days of the 1914–1918 war are indicated by the following table:

	Trips	Patients
Duguay-Trouin	12	10,525
La Bretagne	10	8,086
Tchad	7	6,378
Amiral-Duperre	5	3,286
Ceylon	5	2,952
Total evacuated		31,227

The activities of seven other hospital ships during the second half of this war are represented below:

	Beds	Trips	Patients		Beds	Trips	Patients
André Lebon	984	13	11,050	Navarre	750	17	10,359
Asie	750	15	14,430	Sphinx	1,000	25	21,345
Flandre	820	20	13,799				
France IV	2,500	8	20,000	Total	7,804	121	112,120
Lafayette	1,000	23	21,137				

Development of Hospital Ships in the United States Navy

A rather careful search of naval records has failed to disclose the existence of hospital ships in the United States Navy prior to the outbreak of the Civil War. Emmons, in his list of American naval vessels, 1775 to 1853, does not mention a hospital ship.

However, the American naval authorities over 100 years ago recognized the importance of hospital ships, and their use was contemplated, as indicated by the fact that the official instructions of this period specifically defined some of the functions of such ships and prescribed that the assigned position in the fleet should be maintained. Some eight years before the promulgation of these instructions, Edward Cutbush, of the American Navy, in his "Observations on the Means of Preserving the Health of Soldiers and Sailors," Philadelphia, 1808, speaks of a hospital vessel. He says that a hospital ship should be "large, dry, and commodious," fitted up for the express purpose with cradles, bunks, or cots, and should be supplied with bathing tubs. "Some of the sailors' wives, if attached to the ship, would make good nurses, far preferable to orderly men. *Hospital ships should be supplied with livestock* and every article necessary to render the situation of the sick as comfortable as in hospitals ashore." Cutbush proposed hospitals ashore "because there generally will be a sufficient supply for the hospital ship, after the squadron leaves the port."

The following was abstracted from "Rules and Regulations and Instructions for the Naval Service of the United States, 1818":

The surgeon of the fleet is to be on board the hospital ship, if there be one in the squadron; if there be not, he is to be on board such ship, or at such place on shore, as the commander in chief shall direct.

HOSPITAL SHIP

1. The captain of an hospital ship is to be particularly attentive to see that the ship is kept perfectly clean, especially that part which is appropriated to the sick. He is to give strict orders that the buckets used by the sick are frequently emptied and washed, and that the dressings of wounds or sores be thrown overboard as soon as they are taken off.

2. He is to attend to all requisitions or proposals of the hospital surgeon, and, as far as circumstances may admit, to do whatever he may recommend for the comfort and convenience of the sick. The best provisions on board must always be appropriated to the use of the sick.

3. He is to be careful in preventing wine or spirituous liquors being carried on board without his express permission.

4. He is to keep the station assigned him in the fleet, particularly when he is directed to attend to a ship, the crew of which is sickly and may frequently require the assistance of the hospital surgeon.

5. In addition to the complement of an hospital ship, there shall be borne, as attendants on the sick, on a list of supernumeraries for wages and victuals, a surgeon, two, or if necessary, three assistant surgeons, six landsmen as nurses, a baker, four washermen, a servant to the hospital surgeon, and a servant to the surgeon's mates.

6. The captain of the hospital ship, or the captain of any other ship in which the hospital surgeon shall be embarked, is to furnish him with a proper boat, whenever he shall think it necessary to visit any ship of the fleet, or to carry his returns to the commander in chief.

Extensive use was made of hospital ships by the Federal forces operating on the Mississippi River during the American Civil War, and the official records speak very highly of the character of services rendered.

The most satisfactorily equipped hospital vessel appears to have been the *Red Rover*, described as a veritable palace in the days of sixty-one. It had bathrooms, laundry, elevators between decks, amputating room, and even screened portholes, and was actually equipped with an ice machine, whose product was so much in demand by other organizations that a general order was issued regulating the issue of the same.

The *Red Rover*, commissioned December 26, 1862, at Cairo, Ill., was a captured Confederate vessel, and was fitted out as a hospital ship by Quartermaster George M. Wise, and carried a battery consisting of one 32-pounder. Dr. George H. Bixby, of Cairo, Ill., was placed in charge. The expense of equipping this vessel was partially defrayed by the Western Sanitary Commission.

The hospital ship *City of Memphis* carried 11,024 sick and wounded in 33 trips up and down the Mississippi River.

The *D. A. January*, in charge of Asst. Surg. A. H. Hoff, cared for 23,738 patients during the last three years of the war.

The *Empress*, the *Louisiana*, and the *Imperial* were also used as medical transports during the Civil War.

The official register of naval officers, United States Navy, for 1862, lists a medical officer attached to the "hospital ship *Benjamin Morgan*," which appears to have served the North Atlantic Squadron. This ship, 407 tons displacement, is also given as an ordnance ship.

and it is most probable that the vessel served other than strictly medical purposes.

It would appear—and is naturally to be expected—that duty on a hospital ship was not very desirable to line officers, as inferred from the request of Captain McDaniells to be relieved from duty on the *Red Rover*, quoted in a message from C. H. Davis, Flag Officer, Commanding United States Naval Forces, Western Waters, when off Vicksburg, July 18, 1862. He was relieved by Acting Master W. R. Wells, who in turn was relieved by Acting Ensign Charles King, both of whom appear to have held a much lower rank than the original senior line officer on board.

Isolation ships, in the form of river barges for smallpox patients, were in use at this time to serve the forces operating on the Mississippi River.

So far as could be ascertained the Confederate Navy employed no hospital vessel, although the regulations of the navy of the Confederate States, page 126, allude to a hospital ship. It is interesting to note, *en passant*, that Gen. T. T. ("Stonewall") Jackson, of the Confederate Army, was one of the first commanders to recognize the immunity of a medical department, and his attitude on this matter was said to be largely instrumental in stimulating the Geneva Convention which met a few years later and gave official international sanction to this principle (5). General Lee adopted this principle about 10 days later.

The *Jamestown*, described as a "store and hospital ship," while off Panama in December, 1866, treated 48 cases of yellow fever, 21 of which died (Bloodgood) (6). The *Jamestown*, launched in 1844 at Norfolk, Va., was ordered on November 10, 1865, to be converted into a store ship, and on September 9, 1892, she was transferred to the Marine Hospital Service.

The American forces employed the following hospital vessels in the Spanish-American War: *Vigilancia*, *Relief*, *Missouri*, *Bay State*, *Olivette*, and *Solace*.

The *Relief* rendered service in the Boxer troubles in China in 1900. She was placed out of commission in 1901 as a hospital ship, and in 1908, after extensive alterations, was recommissioned for hospital purposes, accompanying the fleet in its cruise around the world as far as the Philippines, where she served as a floating hospital at Olongapo.

In the World War the vessels of the United States Navy devoted primarily to medical purposes totaled 48,375 tons displacement. A list of these vessels is given in the following table:

Vessels of United States Navy used primarily for medical purposes in the World War

	Tons displacement	Duty at close of war [1]
Adrian	330	Fifth naval district.
Boston	3,000	Acted as tender to receiving ship of first naval district.
Boston Floating Hospital	1,200	First naval district.
Comfort [2]	10,102	Atlantic Fleet.
Mercy [2]	10,112	Do.
Newark	4,083	Quarantine ship.
Repose	3,300	Floating dispensary to Asiatic Fleet (formerly Relief).
Sea Gate	400	Ambulance boat.
Solace [2]	5,700	Atlantic Fleet.
Southport	330	Ambulance boat.
Number 1	9,800	Laid down at Philadelphia Navy Yard in 1916, 24 per cent completed when work was discontinued at outbreak of World War.

[1] Duty as listed in ships Data Book, U. S. Navy, of Nov. 1, 1918.
[2] Vessels considered as functioning as class A hospital ship.

The *Comfort* and *Mercy*—formerly the *Saratoga* and *Havana* of the Ward Line—were converted into hospital ships in the early part of 1918.

The commissioning of the hospital ship *Relief* on December 28, 1920, may be termed epochal, she being the first modern ship built from the keel up as a hospital ship. The untiring efforts of Rear Admiral W. C. Braisted, Medical Corps, United States Navy, in obtaining the necessary appropriations, and the indefatigable activities of Capt. R. C. Holcomb, Medical Corps, United States Navy, in planning and supervising her building, were largely responsible for the excellent hospital vessel now serving our forces afloat.

It has been recommended that the building policy of the United States Navy should include a new hospital ship each 10 years. Converted hospital ships have been scrapped in much less time than this. The *Solace* since her last conversion stayed in commission for 10 years. This 10-year period would provide a regular program commensurate with the growth of the fleet. The *Relief*, which was appropriated for in 1916, might well be followed by a modern ship of improved design (Holcomb).

Military Value of Hospital Ships

An endeavor has been made throughout this discussion to limit the remarks to those pertaining to our military mission—i. e., to conserve physical power—and to omit the humanitarian aspects of the mission of a naval medical department. Hence, in presenting the arguments for extensive use of hospital ships, military aspects only will be stressed. It is believed that a careful study of the military assistance rendered by hospital ships in peace and war will compel the conclusion that such vessels are an essential component at all times of the forces afloat.

The writer feels that he can not be too emphatic in forcibly presenting the point that military medical activities are, and should be, actuated primarily by a motive to increase the military efficiency of the organization of which the medical department is a component; therefore, in advocating the extensive use of hospital vessels to care for the disabled, humanitarian consideration, while important, will not be included in the discussion.

The primary object of a hospital ship is to " add, to the limit of its possibilities, to the efficiency of the fleet " (Stokes).

It required centuries of land warfare for commanders to recognize that, instead of leaving their wounded to die on the field of battle, an efficiently organized medical service was an important factor in military success, as such service operated to frustrate the action of the enemy, accomplishing this by transforming "a battle casualty into a replacement."

Failure to realize the military importance of extensive use of hospital ships and medical transports is equivalent to opposing a firmly established principle in warfare ashore. The proposed use of returning troop transports to serve as hospital transportation for those disabled overseas compels the wounded to incur risks and utilizes a nonmedical institution for medical purposes. Therefore it is not in accord with a basic international regulation, as well as a fundamental medical principle. The people of the United States are essentially humanitarian, and it is questionable whether popular opinion will long permit the practice of using returning troop ships to convey homeward the disabled who are entitled to the immunities of war accorded by international conventions.

Unfortunately the sinking of numerous hospital ships by Germany in the World War forced the American Government to use returning transports, convoyed homeward, as a safer procedure than would have been the employment of unconvoyed hospital ships.

Mr. Arnold-Foster in 1902 said in Parliament that the policy of using hospital ships for the navy had been deliberately adopted after a great deal of mature consideration by the Admiralty.

The presence of the hospital ship with the naval forces in time of peace as well as in time of war has been abundantly justified by the splendid work which has been accomplished. (Pryor's Naval Hygiene.)

Vice Admiral Paschen, in the Dutch Review of April, 1904, says: "All the civilized States in their plan of operation at Sea, in case of war, have foreseen the need of hospital ships on high seas."

Hospital ships constitute one of the essential elements necessary for a naval medical service to accomplish successfully its mission of the "conservation of physical power." The Annual Report of the

Surgeon General, United States Navy, 1915, states, "The necessity for hospital ships with the fleet has been fully demonstrated. It is inconceivable that the Navy should ever be without them. * * *" The 1917 report states, "The need for the services of a hospital ship in this fleet is apparent, and the lack of such services has resulted in a diminished conservation of life and health in the personnel."

The medical equipment of a combatant ship, elaborate as it is compared to former days, can not be regarded as furnishing complete hospital facilities as this phase is now interpreted, and it may be regarded as axiomatic that hospital facilities can only be found on hospital ships and in shore hospitals. Electrocardiograph, elaborate X-ray apparatus, physiotherapy, laboratories for special technique, and specially trained experts are available only on hospital ships.

Following is an extract from the annual report for the fiscal year ending June 30, 1910, of Rear Admiral Seaton Schroeder, commander in chief of the Atlantic Fleet:

> The hospital ship has been most efficient as a fleet auxiliary. The professional work has been of the high character to warrant the confidence of officers and men. The transferring at sea of sick during the recent target practice was an additional proof of the use of the hospital ship.
>
> The hospital ship *Solace* has acted as a base hospital and has shown the advantage of such a ship in the ability to immediately transfer cases of a serious magnitude or those having a prolonged convalescence.

Medical Inspector J. C. Boyd, United States Navy, in the Report of the Surgeon General, for 1902, wrote:

> The removal as soon as practicable of those seriously ill or disabled from the confined and restricted sick quarters of battle ships and cruisers to more commodious accommodations either ashore or afloat is recognized as an indispensable requirement and an inevitable condition if the military integrity of a squadron is to be preserved.
>
> A large sick list, a personnel crippled by casualties or enfeebled through climatic or other causes, all constitute sources of weakness to any ship and a cause for anxiety in time of an emergency.
>
> In the event of war between two nations in which the control of the sea is of paramount importance no one will question seriously the advantages to be derived by providing every squadron with one or more hospital or ambulance ships, the number allowed to be based upon the total fighting complement of the ships and the probable percentage of officers and men that will be killed and wounded during an engagement between modern war ships.

The value of the United States hospital ship *Relief* during the past year (1925) in assisting toward the conservation of health in the forces afloat may be represented by the following activities:

Major surgical operations	577
Eye, ear, nose, and throat operations	186
X-ray examinations	2,532
Dental patients treated	3,490
Laboratory examinations (over)	10,000

On this vessel in 1924 over 4,000 nose and throat examinations were made, 158 appendectomies were performed, 1,540 specimens of blood were examined, and 300 surgical consultations were held. These figures should show conclusively the indispensability of hospital vessels operating with the fleet in time of peace.

"Hospital ships steadily worked in peace time will habituate the service to their use in war. This will go a long way toward rendering a fleet or a squadron independent of fixed bases which it may be impossible to form except at inconveniently distant points. It will, perhaps, appear more costly than the plan of establishing Government hospitals at fixed bases; but in the first place this is not certain, and in the second place the excess of cost, if any, may be justifiably incurred, because it will be due to the adoption of a plan promising increased efficiency in war." (Bridge.)

The primary function of a military force in time of peace is the preparation for war-time conditions. The periodic fleet maneuvers, target practices, general quarters, and other drills take place under simulated war conditions. The presence of hospital ships with the fleet during maneuvers should not be alone for the purpose of handling professional cases occurring in the fleet, but to try out and to test the usefulness and limitations of such vessels for war conditions and to indoctrinate the forces afloat with the results of the lessons acquired from such experience. In the next war of a size requiring the exertion of the maximum naval efforts a fleet of 40 or more hospital ships will be required, and the proper time to outline provisional methods for the proper utilization of such a large number of vessels is during peace. History is replete with many instances of waiting until the outbreak of war for actual experience to decide questions which could have been foreseen and worked out in the peace-time preparedness schedules. Hence the instructional feature—both to the medical and combatant branches—of standard well-equipped hospital ships functioning during maneuvers is considered to be of important military value.

The military importance and necessity of hospital ships in war is forcibly shown by a study of past conflicts of nations, as over three centuries ago—i. e., at the Battle of Beachy Head—in a period when naval surgeons served as ship's barbers, and before the days of elaborate hospital equipment, the military value of hospital ships—purely as a means of relieving the fighting vessels of sick and wounded—was realized. In the present age of highly specialized hospital fittings the military importance of hospital ships to the forces afloat should be of much greater significance.

Hospital ships assist "very materially in maintaining the fighting efficiency of the fleet." (Pannet) (7).

In proportion to the number of wounded removed the fighting efficiency is correspondingly increased, since the presence of sick and injured aboard ship acts as a "mental depressant to the crew." Simons says that the wounded must be removed, not only for their own good but for the preservation of the morale of the uninjured, and cites the case in the Spanish-American War, where 47 wounded Spanish sailors were brought on board an American vessel with rather detrimental results to the morale of the crew.

The military disadvantages ensuing from the restrictions and limitations placed on the action of hospital ships may appear, at first reflection, to detract seriously from their value to forces afloat. This is apparently not the case, as stated by Charles Cheney Hyde in Volume II, International Law, 1922, page 527:

> Properly designated hospital ships when innocently employed are exempt from capture. The Hague Convention of 1907, concerning the adaptation of the principles of the Geneva Convention to maritime warfare, made elaborate provisions respecting the scope of the exemption and the conditions to be observed by vessels claiming it. The military detriment suffered by a belligerent in consequence of yielding the concession is commonly outweighed by the benefit derived from the similar action on the part of the enemy; and it is insignificant as compared with the equities attaching to a vessel devoted to the care of the sick and wounded, provided it abstain from any other form of participation in the war.

Assuming that in the next war the United States is placed at the disadvantage of possessing a fleet of inferior strength, compared to its adversary, it may appear that hospital ships under these circumstances would be of little military value, because of the fact that our fleet would keep under the protection of home bases. On the contrary, according to the eminent naval strategist, Admiral Mahan, the tactics of an inferior fleet demands a high degree of mobility, which condition requires an efficient train—including hospital ships—to enable the main body to keep the high seas. As Admiral Mahan expresses the mission of an inferior fleet:

> Keep the sea as much as possible; on no account to separate his battleships, but to hold them together, seeking mobility by frequent appearances, which unaided rumor always multiplies, to arouse the enemy's anxieties in many directions, so as to induce him to send off detachments; in brief, to occasion what Daveluy calls "displacement of force" unfavorable to the opponent. If he makes the mistake, the individual detachments will be attacked one by one, or the main body if unduly weakened.

Hospital ships aid the military efficiency of a fleet in the following manner:

1. They promote the conservation of physical power by the following means:
   (*a*) Furnish elaborate facilities to make early and accurate diagnoses and thus diminish the number of sick days.

(*b*) Extensive therapeutic devices and supplies hasten the return of patients to duty.
(*c*) Removal to new environments facilitates recovery of certain cases.
(*d*) Diminish the losses from drowning during action.

2. They increase the spaces aboard fighting vessels by reducing the accommodation needed for care of the sick.

3. They assist in the preservation of the morale of the fleet by:
(*a*) Prompt removal of action casualties.
(*b*) Assuring the personnel of adequate and suitable medical attention in case of illness or injury.

4. The mobility of the fleet is increased by the services of hospital ships enabling it to be independent of fixed hospital bases.

5. In time of peace they function:
(*a*) To train medical personnel.
(*b*) To indoctrinate the combatant personnel in the possibilities and limitations of hospital ships' employment during war.

Classification and Definition of Hospital Ships

Hospital ships may be classed as follows:

I. HOSPITAL SHIPS INTENDED FOR THE CARE OF CIVILIAN PERSONNEL

1. *Hospital ships that serve the population of great cities.*—One of the first of this type of institutions was founded in New York in 1875 by the activities of George F. William, editor of one of the large daily newspapers. The boat employed for this purpose was the *Emma Abbott*, which cared for 909,104 patients during the summer seasons from 1875 to 1902, inclusive. The second floating hospital of this nature was the *Helen C. Julliard*, which handled almost 700,000 patients while in service during the years 1889 to 1915, inclusive (Holcomb).

Some of this type are limited to children as patients, giving them the benefit of sea air and a respite from summer heat during their illness. As an example of this class may be mentioned the Boston Floating Hospital and the hospital ship maintained by the Bellevue Hospital of New York City. The *Castalia*, which was bought by the Metropolitan Board of London and converted into a hospital ship for smallpox patients, comes under this category. In connection with this ship there were three steamers for ambulance service, viz. *Red Cross*, *Albert Victor*, and *Maltese Cross* (8).

2. *Hospital ships that serve the civilian maritime personnel.*—The United States Coast Guard cutter *Androscoggin*, under a sur-

geon of the Public Health Service, has been fitted out as a hospital ship for duty among the fishing fleet of the North Atlantic, and the cutter *Algonquin* performed like service to the deep-sea fishing vessels in Alaskan waters (9). The same sort of duty is performed by a French ship, the *Saint Francois d'Assise*—a service established in 1899 by the Société des Oeuvres de Mer.

During the years 1897 to 1907 the hospital ships of the Société des Oeuvres de Mer spoke 6,585 fishing vessels, treated 811 patients on board, with 12,076 sick days, and held 3,250 consultations at sea. They also rescued 297 shipwrecked sailors, returned 351 convalescents and sick men to France, gave medicines to or replenished the medicine chests of 1,295 ships, and received or delivered 212,191 letters. During 1911, as stated in a recent consular report, the *St. Francois d'Assise* steamed 12,209 marine miles, spoke 1,143 vessels, admitted 70 patients to the hospital, and gave treatment at sea in 420 other cases, besides picking up 14 shipwrecked persons (10).

The *Strathcona*, a steamer of 600 tons, was built by Lord Strathcona and presented by him to the Newfoundland Mission. In this ship Doctor Grenfell cruises every year from the Grand Banks to Hudson Bay, treating all who come to him for aid.

II. HOSPITAL SHIPS INTENDED FOR THE CARE OF MILITARY PATIENTS

1. *Hospital ships fulfilling the requirements of the Geneva Convention.*—(*a*) Military hospital ships fitted out by the belligerents. These are painted white with a green strake.

(*b*) Hospital ships commissioned by the belligerents but fitted out at the expense of individuals or relief societies.

(*c*) Hospital ships fitted out by neutrals but controlled by one of the belligerents. This and the above class are painted white with a red strake. (Vide Articles 1, 2, and 3, respectively, of Hague Convention of October 18, 1907, for definition of above three types.)

(*d*) Ships compelled by humanitarian reasons temporarily to accommodate patients. (Vide Article 9 of above-mentioned convention.)

2. *Hospital ships not fulfilling the requirements of the Geneva Convention.*—Hospital ships from which their distinguishing marks have been removed, such as was the case with certain hospital ships of the British Navy, after the German note of January 28, 1917.

Military hospital ships include two distinct types, viz, class A, or fleet hospital ships, and class B, or hospital transports. There is an apparent need for hospital transports to include a small type of ship, which might be described as a third type, "rescue ship." These three classes correspond with Blackwood's conception in which he likens the *fleet hospital ship* to a hospital ashore, the *ambulance ship* is "an analogue of the ambulance vehicle which brings the patients to the

hospital, and the *hospital transport* corresponds to railroad trains or other conveyances which transport the wounded over longer distances" (11). It would, however, tend to simplify matters to regard small ambulance ships as a subdivision of *hospital transports*, and they will be so considered in subsequent discussions.

In order to gain a clear and common conception of the precise significance of the term "hospital ship," it is essential that some definition of the term be agreed upon.

"By hospital ships are meant seagoing vessels, propelled by steam, specially constructed and adapted for treatment of the sick and wounded" (Braidwood) (12). The term hospital ship has been applied quite generally to any ship used as a floating hospital (Holcomb).

McNabb considers a hospital ship as a "ship at the disposal of the Commander in Chief for the purpose of relieving his fleet of sick and providing them with the best possible accommodations and opportunities for treatment in peace time; and in war time undertaking the care of all the wounded resulting from a naval action, so avoiding the necessity for depleting the fleet by having to detach ships to a base to get rid of the wounded" (13).

Hospital ship, broadly speaking, refers to a vessel *the sole purpose of which is to render medical service.*

The term "hospital ship" appearing in the tactical discussion will refer exclusively "*to self-propelled hospital vessels fulfilling the requirements of The Hague Convention of October 18, 1917.*" Stationary vessels—e. g., the old *Relief* at Olongapo—used by the naval medical department, while classed as a hospital ship in the former definition, from a point of view of the Geneva Convention and medical tactics, is a fixed military medical establishment coming under the category of military hospitals and will be so considered.

All merchant ships, yachts, or boats of a neutral power may be considered as potential hospital ships which may be called upon to provide temporary and improvised accommodation for the care of the sick, injured, or shipwrecked of the belligerents, and when this humanitarian service is undertaken they instantly assume the temporary status of a "hospital ship."

According to the United States Army Medical Bulletin, No. 14, 1925, a distinction is made between "hospital ships" and "ships for patients." The latter term is reserved for ships which have been improvised for the reception of patients and may be of any capacity from that of a canal boat to that of a large liner.

The standard hospital ship of the United States Army is of 200 beds' capacity, with a personnel of 5 medical officers and 39 enlisted men.

It is highly probable that the hospital ships of the medical department of the United States Army will function in time of war under orders of the Navy Department.

Suggested types of naval hospital ships

Designation	Medical	Structural	Tactical
Hospital ship, class A. Fleet, high seas, base, or deep sea hospital ship.	200-500 bed capacity. Complete medical, surgical, and hospital equipment for "definitive treatment" of all types of cases.	Oil-burning ship, specially constructed 4,000-10,000 tons displacement.	*Mission:* To furnish hospital facilities for naval and expeditionary forces. Serves as base hospital and remains an integral component of force until relieved by a similar ship.
Hospital ship, class B. Auxiliary hospital ship, hospital carrier, ambulance ship, medical transport, or hospital transport.	Medical, surgical, and hospital facilities sufficient for temporary care of patient. (One type should be small vessels with high speed, designed and equipped for "short hauls" and as rescue ships.)	Converted liners, or other vessels, of varying speeds and tonnage.	*Mission:* To transport medical material and personnel for naval and expeditionary forces. Operates on lines of communication as a system of medical supply and evacuation of patients from theater of operations.

Hospital Ship—Class A

The designations used for this class of hospital ship include the following qualifying terms: *High seas hospital ship*, *fleet hospital ship*, *base hospital ship*, *deep sea hospital ship*, *general service hospital ship*. This class of hospital ships should be composed largely of those to which the symbol AH is applicable; however, the expense involved prevents the maintenance of the war-time requirements of class A vessels, consequently some merchant vessels must be converted to this type of hospital ship.

As a general rule a naval engagement may be anticipated shortly after the opening of hostilities, and for this reason—also in view of the longer preparation required for class A ships and their relative importance—the construction of this class during peace is highly important.

A converted liner is "an expensive and inefficient substitute for a hospital ship," and, as Braisted says, it is about as practicable to convert an old building into a modern hospital as it is to reconstruct a passenger vessel into an efficient hospital ship.

"Merchant ships will never fully satisfy the requirements of hospital ships."

Hospital ships to be "thoroughly efficient must be designed and built for their special mission from the keelson up" (Stokes).

"It is true that much can be accomplished by such haphazard transformations, but until the time comes when ships are designed and constructed for the specific purpose of best performing the function of a hospital ship the fleet will never secure the maximum efficiency which could be obtained from the services of such a ship" (Raison) (14).

Mines are the chief danger for hospital ships; therefore the merchant ship selected for conversion should have many bulkhead compartments. A very high superstructure and boat deck should be avoided, as they render the ship hard to handle and make it difficult to take on and put off boats for rescue work. The ideal hospital ship is one that is built for the purpose, and the nearer a merchant ship approaches it in structure the more suitable it will be.

"The one outstanding advantage of a ship originally designed for hospital purposes is that it would be possible so to arrange the details of construction as to economize space in the highest degree and at the same time to insure that every section occupies the most convenient and appropriate position."

"A fleet hospital ship should have all the departments of a general hospital, including wards for contagious disease. She should have a corps of specialists aboard. Beds should have the maximum of air space; a 15,000-ton ship should provide for the care of about 300 patients. She should be prepared for a large *outpatient* practice. As to the equipment of such a ship, I can only say that she should be so equipped that the man at sea could be assured that he will have the latest and the best medical and surgical treatment, in no way inferior to that accorded to his brother on shore. My experience with the fleet on board hospital ships during the past 15 years leads me to the above conclusions" (Holcomb).

Since it is expensive to maintain a sufficient number of these vessels in peace time, the middle course—said to have been already adopted by the Japanese—of designing certain mercantile craft "with a view to conversion, if required, may become worthy of consideration. Such a plan obviously necesitates restriction to certain trade or passenger routes in order that they may be at hand on emergency" (Sutton).

The function of class A hospital ships is sharp, clear cut, and well defined. They are to serve the forces afloat, or forces in any area, where other hospital facilities are not available, as motile floating hospitals, and, as such, some of them should form an integral component of the cruising fleet at all times. They may be temporarily detached for military reasons, so as not to betray the position of the fleet, but should this separation seriously interfere with their serving the fleet as a floating hospital, then, in my judgment, the removal of all distinguishing marks should be seriously considered in order to permit them to remain with the fleet, not as a "hospital ship" as internationally defined, but as part of the train, incurring the risk of other ships and functioning analogously to the repair ship which repairs mechanical defects.

The transport possibility of class A hospital ships must be considered as purely incidental to their motility, and not as the primary function of these vessels.

The class A ship should never, under any circumstances, "be separated from the fleet or its main base, but always should be at hand to attend the serious and everyday casualties and diseases that the men of the fleet are subject to."

"The hospital ship, as before stated, is merely a floating hospital—a vessel equipped with everything that pertains to hospital use for the care of the sick and injured, whose duty it is to attend the fleet at its base and care for all cases of illness and injury originating in the fleet, who, with a fair degree of certainty, may be able to return soon to their duties on their respective ships. It is not a part of the function of the hospital ship to transport sick and wounded from the fleet to a base hospital ashore, nor is it a part of its function to transport sick and wounded across the ocean. Its equipment is far too elaborate for any such purpose, and the spaces allotted for the different departments are too small for the accommodation of large numbers of such casualties" (Blackwood).

" * * * To use a vessel possessing all the requirements of an up-to-date hospital ship for transportation purposes is a waste of material; if a vessel converted into a hospital ship, whose equipment could not properly be used for anything further than transportation, be assigned to perform the duties of a hospital ship, the wounded would suffer neglect. Such a situation might easily occur, when, in spite of their varying degrees of fitness, one ship is considered as good as another and they are used indiscriminately, regardless of their limitations. * * * " (Straeten).

A class A ship should have sufficient cruising speed and cruising radius to accompany the squadron to which its assignment is contemplated.

Wise regards speed as a *sine qua non*, for without it a hospital ship could not efficiently do the work expected of it.

"* * * To bring these modern appliances of medical science to the most strategic position among the fighting ships we must go a step further—its speed and steaming radius must equal that of the ships of the line."

In view of the fact that hospital ships must remain outside of gun range, Zur Verth believes that high speed is one of the requisites in order to enable them to proceed with dispatch from their position of readiness to the scene where these services are needed during an engagement. It is said that the combatant officers of the German Navy regretted the slow speed of their hospital ships, which impaired their usefulness.

The dispersion of a military force is in violation of the fundamental principle of higher tactics, and hence it is very probable that a concentration of naval forces of a world power within a comparatively small circumscribed area, preliminary to exerting the maximum effort offensively, will assemble naval personnel totaling 100,000 men and officers. Manifestly medical and hospital requirements for a force of this size will be large.

The British fleet, composed almost entirely of combatant ships, at the Battle of Jutland carried 60,000 men and officers, and if it had been accompanied by a sufficient train—store ships, colliers, oilers, cargo ships, tenders, ammunition ships, repair ships, and other auxiliaries—to enable it to be self-sustaining, the total personnel required would have been not far from 100,000. Estimating bed capacity needed for the normal sick and injured and for the battle casualties of a naval campaign, a fleet of this size would require approximately the same number and type of hospital facilities as are usually found in a city of a quarter million inhabitants.

Consequently, a rough estimate of the hospital ships needed in a naval campaign, based on distant ports, would amount, roughly speaking, to the sum total of the hospitals found in our medium-sized cities, and, as these cities find specialized types of hospitals essential, it is not unreasonable to plan on hospital vessels for treatment of special types of diseases and injury.

The primary purpose of class A hospital ships is to provide hospital accommodations, with all the "appurtenances" found in a hospital ashore, and in order to assure their maximum efficiency it would appear not too idealistic and hypothetical to plan special subtypes of this class. It must be remembered that modern warfare has developed into one of great magnitude and there is a tendency in times of peace to underestimate rather than overestimate the quantity and quality of the matériel requirements.

The subdivision and specialization of hospital ships, class A, is in accord with the principle underlying the functions of military hospitals ashore. For example, the advanced hospitals may have special functions, such as the mobile surgical hospital and the hospital for treatment of gassed cases. In the rear of these there are hospital centers—a typical center comprising six general hospitals—which are subdivided into hospitals for the treatment of gunshot fractures, abdominal cases, orthopedic cases, and infectious diseases. Convalescent camps form a unit of the hospital centers ashore.

With the progressive development of higher standards of care and treatment of the sick and injured there has arisen coincidently a demand for better treatment of the casualties of war. Perhaps

the standard of treatment of naval patients has not advanced to the point that the division of class A hospital ships into special subtypes merits serious consideration at the present time, but it would not seem to be too speculative to suggest that the trend in this direction is so marked that cognizance of the same should be taken in making provisional medical arrangements. Whether the naval authorities will be the first to recognize the necessity for the differentiation of general hospital ships into specialized types, or whether the demand of the American public for a higher standard of professional treatment will impel the adoption of this procedure remains to be seen. Of course, it is possible to carry out this idea to such an extreme degree of specialization—as is true along all lines of human endeavor—that it defeats the very purpose for which it is intended, i. e., the greatest good to the greatest number.

At least one hospital ship, class A, should be fitted and function to care for contagious diseases, since this type has been in use for over a century and has proved its value in segregating and treating this class of diseases. In the World War the Royal Navy hospital ship *Agadir* (15) functioned in this capacity, and the following table shows the number of cases received and gives an idea of the proportion of the different types of zymotic diseases to be expected in a naval community:

Disease	Cases	Percentage	Disease	Cases	Percentage
Rubella	249	43.68	Diphtheria	10	1.75
Mumps	200	35.08	Enteric fever	10	1.75
Measles	41	7.19	Varicella	9	1.57
Scarlet fever	25	4.38	Cerebrospinal fever	9	1.57
Erysipelas	17	2.98			

Regarding a hospital ship specially fitted to care for contagious diseases, Blackwood says, "Its function as a hospital ship should not be expanded to take care of any very large number of contagious cases, because these cases may be great in number and of trivial importance in their severity, and the hospital ship would soon become overcrowded with these cases and its utility as a hospital for its legitimate purposes would be destroyed. No argument for this is necessary, as everyone knows who has had any experience with hospitals ashore that the ordinary hospital does not take care of contagious cases, but that special hospitals are built and maintained for the care of contagious diseases. So with the hospital ship; while it may take care of a limited number of contagious cases in order to get them off the fighting ships, it should not be required to take them for any length of time, and the contagious cases should be removed frequently by a contagious disease conveyance or an ambu-

lance ship provided for that purpose. Every fleet should have, in addition to a hospital ship and an ambulance ship, a contagious disease hospital ship similarly equipped to the ordinary contagious hospital ashore."

One or more class A hospital ships should be fitted as convalescent ships to care for the semichronic cases whose recovery and return to the fleet is anticipated. This ship serves to relieve the overcrowding and congestion which may occur on the other hospital vessels, and thus enables the acute cases to receive better attention. It is not improbable that the convalescent ship could make periodic cruises to regions where the climate is more suitable for rapid recovery, i. e., colder climate for the chronic malaria, dysenteric, and other diseases. Convalescent ships have also been in use for centuries, as has been already noted.

Whether it will be advisable to develop the principle of specialization of class A hospital ships to include "medical" and "surgical" types will be left open.

To prevent a too radical departure in the specialization, all hospital ships, class A, must be equipped for general hospital service, and the above-noted specialized functions are to be secondary and utilizable only when the exigencies demand the same.

Hospital Ships—Class B

This class of hospital ship has been denoted by such terms as *auxiliary hospital ship*, *hospital carrier*, *ambulance ship*, *medical transport*, *hospital transport*, *Hilfslazarettschiff*, *transports-hopitaux*.

The majority of these vessels will be converted merchantmen and hence are included under the symbol XAH.

"Conveyance of the wounded to the rear is one of the principal duties of a hospital ship" (Nishi) (16).

While accompanying and attached to a squadron, a hospital ship serves as a "base hospital," but when full of cases requiring transfer ashore, it automatically assumes the function of an "ambulance ship" in conveying such cases to other destinations. "She is no longer a 'hospital ship' *per se*, but becomes a form of a marine medical transport, or, in other words, a 'marine ambulance.' Thus under peace conditions a hospital ship is nothing more than a mobile fleet hospital base endowed with 'ambulance' facilities for use when circumstances require" (17).

In the last war class B hospital ships proved useful to Germany, as this nation was fighting on the interior line of communications, and the wounded were transported short distances to shore hospitals.

England, fighting on exterior lines, found class A hospital ships of greater value than was Germany's experience.

Ships employed for the transportation of the wounded need not be so completely fitted nor possess the speed of hospital ships proper. In classing them apart let us designate these vessels used for transportation purposes as hospital transports. They may be easily converted from any well-ventilated merchant vessel. The cost of this, as well as their upkeep, would be small compared to the well-fitted hospital ships, and by doing this subsidiary work would enable the hospital ships to remain where their services are of greatest value. In case the scene of action is located at a great distance from the American coast, vessels bringing supplies to the fleet may be used, in addition to the regular transports, to carry convalescent wounded on their return trip to the United States (18).

Medical transports—class B hospital ships—are designed to function primarily on the lines of communication, transporting medical material and personnel to the theater of operations, and evacuating patients from this area. The longer the lines of communication the more this class will approach class A in equipment and construction.

The hospital transports evacuating from Gallipoli differed in their arrangements and equipment from those employed to carry patients from France to the British Isles, where the journey was about 24 hours. The services of hospital transports are most in demand after the naval forces are established overseas, hence their presence with the advancing fleet is of little import.

Medical transports—similar to the requirements for troop transports (XAPs)—should be of about 7,000 tons displacement. Good speed—10 to 16 knots—twin screws, bilge keels, water-tight bulkheads, deck spaces at least 7 feet under beams, salon with seating capacity of from 40 to 50, and space for smoking room, constitute some of the desirable characteristics for the vessels selected for conversion into hospital ship, class B. They should be supplied with a number of boats, two of which are motor boats. Ice machines, radio communication, dynamo plant of sufficient capacity, booms and winches for handling boats and supplies, should be a part of the equipment of medical transport.

Moderate cabin accommodation should be provided. The spaces should be clear, sheathed, well ventilated, and have ports 11 to 13 inches in diameter (Carpenter).

The hospital transports being largely evacuating agents, feeding base and naval hospitals, should not be reckoned as furnishing a quota of the bed requirements.

Large liners have some advantages—compared to medium-size vessels—for conversion into class B hospital ships. One of the largest hospital ships was the *Aquitania*, which was twice fitted out for this purpose. Her large capacity, 4,000 patients, rendered her economical

in medical personnel and in tons displacement, and she was comparatively steady at sea.

The disadvantages of a ship of this size have been enumerated:

(*a*) Uneconomical, unless handling large number of patients.

(*b*) Able to enter but few ports.

(*c*) Presents large target to torpedoes (if no international law prevails).

Medical transports returning from home ports to the "fleet zone" may be utilized for the transportation of medical matériel, thus functioning as medical supply ships. The British, however, are of the opinion that it is advisable to prohibit hospital ships from carrying medical personnel other than those serving permanently on board and from transporting surplus medical matériel, inasmuch as cotton, rubber, and fats might be transported under this pretext and converted to nonmedical purposes (19).

In a distant naval campaign, with the enemy's submarines and airplanes continually attacking transport vessels on the lines of communication ("transportation zone"), it should cause a state of mental tranquillity to the naval authorities to know that medical, surgical, and hospital supplies essential for the care and relief of the sick, wounded, and dying of the overseas forces are being conveyed safely in hospital ships afforded the immunities of war by the international conventions.

It is almost axiomatic of a military disaster that the shortage of medical supplies and hospital facilities will be among the first of the alleged defects to be uncovered. The daily press was so replete with the alleged breakdown of the British medical service in the Mesopotamia campaign that one was almost led to assume that the alleged defects of this service were the primary cause of the military failure. While on this subject, attention is invited to the fact that while the military medical department is one of the components of the military organization, yet there are occasions where our functions are advisory, and often our recommendations are not put in effect because military conditions render them impracticable. Hence, in a medical fiasco, there may be occasions where the combatant branch can not evade sharing a varying degree of the responsibility for inadequacy or impaired functioning of the medical service. The medical department is charged with the duty of recommending the number and character of medical facilities, such as hospital vessels, and should the superior authorities, after estimating the general situation, decide that the diversions of the recommended number of vessels to medical purposes is not feasible, under these circumstances the authority responsible for inadequacy of medical equipment and supplies—because of the lack of medical transports—should be quite evident.

Small, swift hospital ships—designated as small ambulance or rescue ships—should perhaps form a special type of class B hospital ship, and converted obsolete destroyers should prove an excellent type of vessel suitable for this purpose.

While the proposed use of obsolete destroyers converted into rescue hospital ships was an original conception, I find in reading the literature for the preparation of this article that the idea is by no means new, and has been considered in some detail independently by others, for example, zur Verth and Elder.

Zur Verth, writing of rescue hospital ships says, "Undoubtedly such a vessel could be of use during a sea fight, and particularly directly after the engagement, yet during the entire war such vessels lay idle, as though superfluous." The Germans apparently planned upon this type of ship, but later gave up the idea of a special type of rescue ship. The Grand Duke Von Oldenburg offered his yacht *Leusahr* for fitting out as a rescue hospital ship.

The proposed type of rescue ship is somewhat similar in design to the "ambulance ship" described below by Blackwood:

> It should be a ship of moderate size capable of carrying from 100 to 150 cases and so arranged as to be able to segregate the various kinds of contagious diseases, and also the medical, surgical, and other cases that it might carry from fleet to the base hospital ashore. This ambulance ship should make periodical trips from the fleet and transfer the cases of illness and injury which are apparently destined to a long convalescence or whose convalescence will be benefited by the freer life ashore and also to relieve any congestion which may take place aboard the hospital ship itself. The equipment of the ambulance ship is simple in character, its principal needs being a small operating room and large dressing room for renewing dressings and performing minor surgery, with large spaces for ambulant cases and a sufficient number of bunks to accommodate the more seriously ill. Its galley accommodations should be of the emergency type, but capable of furnishing quickly special diets and meals for the total number of patients that it can carry. The trips which the ambulance ship would make would in all probability be short, occupying not more than five or ten hours, and the patients, therefore, would require attention and care only during that period. A fairly large staff of nurses might be necessary, but the medical and surgical staff could be comparatively small.

Should the proposed use of rescue hospital ships be deemed not feasible, as an alternative the project presented by Dr. G. W. Boland to the International Red Cross Committee on February 12, 1913, may be considered. This authority proposed the construction of three or more naval hospital ships—maintained and controlled by the International Committee of the Red Cross. In times of peace these vessels would be available to render humanitarian service during epidemics, natural catastrophies, such as earthquakes, floods, famines, volcanic eruptions, etc.

In times of great war, these vessels being under international direction, one can be placed at the disposal of each belligerent, while the third hospital ship will be held in reserve for calamities and disasters in the civilian population.

Small ambulance ships should be suitable for cruising in such harbors as New York and Chesapeake Bay, to visit patrol boats, removing from them sick and injured and taking them to hospital, renewing medical stores, and furnishing transportation to medical officers, to inspect and treat naval pesonnel. Ships of this type would enable the medical officer to visit the incoming ships of the Naval Overseas Transportation Service, and to remove with dispatch patients needing hospital care. (Annual Report of the Secretary of the Navy, for fiscal year 1918.)

The ultimate aim of a naval commander is to win the engagement, and personnel destruction of his adversary's force is one of the principle means open to him to attain this objective. As a component of a naval organization, a naval medical department must assist, support, and contribute to the success of the organization by every means possible that is not in violation of preagreed international conventional rules and customs.

Our employment of such ships specially equipped to rescue personnel from drowning is directed toward denying the enemy the advantage of securing larger personnel losses among our own forces than we can cause in the enemy's forces. The fact that rescue ships can diminish the loss from drowning does not necessarily serve to lessen the military gains resulting from a naval victory, since the Hague Convention provides that the wounded and shipwrecked on noncombatant vessels are subject to capture.

Granted that hospital ships succeed in rescuing the personnel of at least one sinking or burning vessel, the conservation of several hundred trained personnel should be of sufficient military importance to warrant the expenditure of money and effort necessary to utilize this class of ship for this purpose. The employment of such ships during a naval engagement augments the fighting force to the extent that combatant vessels need not be delegated to this use at the critical time when their services are most needed to deliver blows agains the enemy.

The functions of this small type of medical transport may be summarized as:

1. To act as an intermediate ship in collecting patients from the vessels of the fleet and transshipping them to hospital ships.

2. To transport patients for other short hauls, not exceeding 24–48 hours, such as from hospital ship to advanced base hospitals or to large hospital transports.

3. To serve as rescue ships in a naval engagement.

A large quantity of clothing, socks, underwear, shoes, etc., should be carried on board rescue hospital ships to be served out to the shipwrecked.

Hospital Ship Requirement

Class A hospital ships.—Basing the estimate upon the number of persons aboard the Grand Fleet at Jutland, it appears reasonable to assume that the warships of one of the modern powers, concentrated for a major effort, will carry at least 50,000 men and officers. The train necessary to enable the fleet to be self-sustaining will approximate a like figure, bringing the total to 100,000 personnel.

The sick and wounded and battle casualty estimates on pages 201–211 of the April, 1926, issue of this publication will furnish a basis for ascertaining the probable number of class A hospital ships required for a force of this size. The daily number of patients evacuable from forces afloat to naval hospitals (including hospital ships) was found to average 0.041 per hundred of the complement, and the average period for individual hospital cases were 32.54 sick days. Multiplying these two figures together the result is 1.33, which represents the *average percentage of forces afloat constantly under treatment in hospitals (including hospital ships)*.

Hence, for a force of 100,000 men, the hospital beds constantly occupied will average 1,333. This figure represents the average, and, as fluctuations will be caused by small epidemics, climatic factors, and other conditions influencing health, it is believed that bed accommodations for 2,000 patients should be planned upon. The standard class A hospital ship has 350 beds; hence seven class A hospital ships will be required to furnish the necessary bed capacity. (These ships are supposed to be capable of expanding to 500 beds, but only in temporary emergencies; consequently the expansion facilities should not be considered available for routine cases.)

In a naval engagement, all, or at least a large part, of the battle casualties will occur on combatant ships; hence in making hospital provisions for the wounded little or no allowance need be made for the personnel of the train.

According to former estimates (*vide supra* for reference) the force casualty rate was assumed to be 20 per cent, with a ratio of killed to wounded of 1 to 1, resulting in a force wounded rate of 10 per cent. Thus for a force of 50,000 on board the combatant ships, engaged in a decisive naval battle, it is estimated that 5,000 will be wounded; an estimate that is perhaps too high rather than too low, but a small margin of safety is advisable. Hill, in his analysis of the British casualties at Jutland, divides the wounded

into 213 severe cases and 376 slight cases; therefore, on this basis, of the 5,000 wounded, approximately 2,000 will require hospitalization—to accommodate whom four hospital ships, class A, utilizing their emergency expansion of 500 beds, should suffice. It may appear that this is an excessive number of hospital vessels to maintain exclusively for battle casualties, but this assumption is not correct, as the services of these ships will be utilizable in event of large epidemics and to replace other hospital vessels undergoing repairs or other enforced absence. Hence it seems fair to *assume that 11 class A hospital ships will be required to furnish accommodations for the fleet in a major effort in order to enable the fleet to be independent of fixed sanitary bases.*

Class B hospital ships.—There is no accurate data upon which to base computations of the required number of class B hospital ships, much depending upon the type of naval campaigns, length of lines of communication, the size of the Marine Corps and Army expeditionary forces, the availability of shore hospitals, etc.

The British employed over 40 hospital transports in the Gallipoli campaign. As a rough estimate, it is believed that 15 medical transports will be required to serve the naval forces when based on an advanced base located overseas. In the event that the returning transports are used to bring home the convalescent and disabled, this number may be materially reduced.

The number of hospital transports may appear rather small and perhaps it is; however, the sick and disabled that require transportation to home ports should be comparatively few in number. For instance, 82.73 per cent of the Japanese naval wounded in the Russo-Japanese War recovered sufficiently to be returned aboard ship for further duty. As Surgeon General Ireland says, the military object of hospitalization is merely to change a casualty into a replacement; hence in an overseas action plans should be made to establish sufficient hospital accommodations overseas to convert the casualties into replacements and thus eliminate the necessity of returning the utilizable casualties to home ports. Approximately, only 20 per cent of the casualties of battle need be returned to the United States.

Should one or both of the belligerents fail to comply with the requirements to respect the neutrality of hospital ships, then no class B hospital ships will be provided and—as was our experience in the World War—the oversea wounded will be returned to home bases by the returning transports.

The so-called rescue ships, small ambulance ships, should total at least 10. This brings the total of all classes of hospital ships to 36—a number which seems large when considered in the tranquil days of peace, yet this number is considerably less than the requirement found necessary by Great Britain in the War of 1914–1918.

Summarizing the number required:

Class A hospital ships	11
Class B hospital ships (including 10 rescue ships)	25
Total	36

Medical personnel.—It is highly probable that "hospital ship units," corresponding to the present and past system of organizing Navy base units, will be developed to meet the personnel needs of hospital ships. With this in view, the subjoined table has been worked out in an endeavor to standardize the requirements, although manifestly it is impracticable to standardize hospital ships if the vessels available for conversion are not approximately of the same tonnage displacement.

Types of hospital ship	Officers			Nurse Corps	Hospital Corps				
	Medical	Dental	Pharmacists		C. Ph. M.	Ph. M. 1c.	Ph. M. 2c.	Lower ratings	Total
XAH and AH, class A	12	2	5	15	7	16	37	66	126
XAH, class B	6	1	3	8	6	12	30	78	126

International Conventions Relating to Hospital Ships

Red Cross agreements were effective at the Battle of Dettinger (1743) and the Bridge of Lodi (1796), and there were five precursors of the Geneva Convention between 1743 and 1864 (Garrison, History of Medicine, p. 414).

Henri Dunant, a Swiss, born at Geneva on May 8, 1824, inspired by the magnificent work performed by Florence Nightingale in the Crimean War, devoted himself to the relief of the suffering at the Battle of Solferino. In 1862 his book depicting the suffering of the wounded of this battle led to the international conference held informally at Geneva one year later (20).

In all there has been four international conventions on warfare, two at Geneva for war on land (1864 and 1906) and two at The Hague for sea warfare (1899 and 1907).

Upon suggestion of the Government of Italy, representatives of the powers met at Geneva in 1868 and drew up several articles to meet the necessary requirements of war at sea. These remained, however, a "dead letter" for 25 years and the convention was not ratified by the various states. By mutual agreement, they were observed by the belligerents in the Franco-Prussian, Chile-Peruvian, and Spanish-American wars. At the First Hague Conference, 1899, the substance of these articles, after modification, was adopted and

later ratified by the principal powers. The Tenth Convention, of the Second Hague Peace Conference, adapted naval warfare to the principles of the Geneva Convention of 1906 with further amplifications and qualifications (Carpenter).

In absence of specific provisions, to cover special situations, much must be left to the humane initiative and discretion of the belligerents. The underlying principles are general in scope and serve to guide the actions of the victor, or vanquished, in endeavoring to ameliorate the condition of the sick, wounded, and dying; yet the experiences of past conflicts have demonstrated, as will be seen, the necessity of promulgating further instructions, defining in more specific terms what function the hospital ships are prohibited from performing.

"As a means of safeguarding hospital ships and of facilitating their legitimate employment, there is need of further international arrangement announcing with precision the particular services which such vessels are forbidden to perform, and prohibiting attacks on them unless they are armed" (21).

Certain clauses of the Hague Convention "present ambiguities and require more precise definition," and to an "unscrupulous enemy it offers opportunities of profiting by these ambiguities."

The phrase "sick and wounded of the belligerents" in article 4, should be more definite regarding those who are and are not entitled to the benefits of the convention (19).

"Au cours de leurs missions, quelques rares incidents ont surgi à bord des certains bâtiments, montrant qu'il y aurait lieu de faire preciser certains points par des conventions internationales complétant ou interprétant les règles traceés par la convention de la Haye. De ce nombre sont la qualité du personnel et la nature du matériel pouvant être transportés à bord, et aussi les limites dans lesquelles peuvent être recueillis des naufragés ou acceptés des passagers que voudrait embarquer à leur bord un navire ennemi" (Chastang) (22).

Since the tactical employment of hospital ships is dependent in a more or less degree upon international rules on this subject, it might be well to quote such as a source of ready reference before considering subsequent remarks in this article:

THE TENTH CONVENTION OF THE SECOND HAGUE PEACE CONFERENCE, OCTOBER 18, 1907, FOR THE ADAPTATION OF THE PRINCIPLES OF THE GENEVA CONVENTION OF JULY 6, 1906, TO MARITIME WARFARE

ARTICLE 1. Military hospital ships, that is to say, ships constructed or assigned by States specially and solely with a view to assisting the wounded, sick, and shipwrecked, the names of which have been communicated to the belligerent powers at the commencement or during the course of hostilities, and in any

case before they are employed, shall be respected, and can not be captured while hostilities last.

These ships, moreover, are not on the same footing as warships as regards their stay in a neutral port.

ART. 2. Hospital ships, equipped wholly or in part at the expense of private individuals or officially recognized relief societies, shall be likewise respected and exempt from capture, if the belligerent power to whom they belong has given them an official commission and has notified their names to the hostile power at the commencement of or during hostilities, and in any case before they are employed.

These ships must be provided with a certificate from the competent authorities declaring that the vessels have been under their control while fitting out and on final departure.

ART. 3. Hospital ships, equipped wholly or in part at the expense of private individuals or officially recognized societies of neutral countries, shall be respected and exempt from capture on condition that they are placed under the control of one of the belligerents, with the previous consent of their own Government and with the authorization of the belligerent himself and that the latter has notified their names to his adversary at the commencement of or during hostilities, and in any case before they are employed.

ART. 4. The ships mentioned in articles 1, 2, and 3 shall afford relief and assistance to the wounded, sick, and shipwrecked of the belligerents without distinction of nationality.

The Governments undertake not to use these ships for any military purpose.

These vessels must in nowise hamper the movements of the combatants.

During and after an engagement they will act at their own risk and peril.

The belligerents shall have the right to control and search them; they can refuse to help them, order them off, make them take a certain course, and put a commissioner on board; they can even detain them, if important circumstances require it.

As far as possible, the belligerents shall enter in the log of the hospital ships the orders which they give them.

ART. 5. Military hospital ships shall be distinguished by being painted white outside with a horizontal band of green about a meter and a half in breadth.

The ships mentioned in articles 2 and 3 shall be distinguished by being painted white outside with a horizontal band of red about a meter and a half in breadth.

The boats of the ships above mentioned, as also small craft which may be used for hospital work, shall be distinguished by similar painting.

All hospital ships shall make themselves known by hoisting, with their national flag, the white flag with a red cross provided by the Geneva Convention, and further, if they belong to a neutral State, by flying at the mainmast the national flag of the belligerent under whose control they are placed.

Hospital ships, which in the terms of article 4, are detained by the enemy, must haul down the national flag of the belligerent to whom they belong.

The ships and boats above mentioned which wish to insure by night the freedom fom inteference to which they are entitled must, subject to the assent of the belligerent they are accompanying, take the necessary measures to render their special painting sufficiently plain.

ART. 6. The distinguishing signs referred to in article 5 can only be used, whether in time of peace or war, for protecting or indicating the ship therein mentioned.

ART. 7. In the case of a fight on board a warship the sick wards shall be respected and spared as far as possible.

The sick wards and the material belonging to them remain subject to the laws of war; they can not, however, be used for any purpose other than that for which they were originally intended so long as they are required for the sick and wounded.

The commander, however, into whose power they have fallen may apply them to other purposes, if the military situation requires it, after seeing that the sick and wounded on board are properly provided for.

ART. 8. Hospital ships and sick wards of vessels are no longer entitled to protection if they are employed for the purpose of injuring the enemy.

The fact of the staff of the said ships and sick wards being armed for maintaining order and for defending the sick and wounded, and the presence of wireless telegraphy apparatus on board, is not a sufficient reason for withdrawing protection.

ART. 9. Belligerents may appeal to the charity of the commanders of neutral merchant ships, yachts, or boats to take on board and tend the sick and wounded.

Vessels responding to this appeal, and also vessels which have of their own accord rescued sick, wounded, or shipwrecked men, shall enjoy special protection and certain immunities. In no case can they be captured for having such persons on board, but, apart from special undertakings that have been made to them, they remain liable to capture for any violations of neutrality they may have committed.

ART. 10. The religious, medical, and hospital staff of any captured ship is inviolable, and its members can not be made prisoners of war. On leaving the ship they take away with them the objects and surgical instruments which are their own private property.

This staff shall continue to discharge its duties while necessary, and can afterwards leave when the commander in chief considers it possible.

The belligerents must guarantee to the said staff, when it has fallen into their hands, the same allowances and pay which are given to the staff of corresponding rank in their own navy.

ART. 11. Sailors and soldiers on board, when sick or wounded, as well as other persons officially attached to fleets or armies, whatever their nationality, shall be respected and tended by the captors.

ART. 12. Any warship belonging to a belligerent may demand that sick, wounded, or shipwrecked men on board military hospital ships, hospital ships belonging to relief societies or to private individuals, merchant ships, yachts, or boats, whatever the nationality of these vessels, should be handed over.

ART. 13. If sick, wounded, or shipwrecked persons are taken on board a neutral warship, every possible precaution must be taken that they do not again take part in the operations of the war.

ART. 14. The shipwrecked, wounded, or sick of one of the belligerents who fall into the power of the other belligerent are prisoners of war. The captor must decide, according to the circumstances, whether to keep them, send them to a port of his own country, to a neutral port, or even to an enemy port. In this last case prisoners thus repatriated can not serve again while the war lasts.

ART. 15. The shipwrecked, sick, or wounded, who are landed at a neutral port with the consent of the local authorities must, unless an arrangement is made to the contrary between the neutral State and the belligerent State,

be guarded by the neutral State so as to prevent their again taking part in the operations of the war.

The expenses of tending them in hospital and interning them shall be borne by the State to which the shipwrecked, sick, or wounded persons belong.

ART. 16. After every engagement, the two belligerents, so far as military interests permit, shall take steps to look for the shipwrecked, sick, and wounded, and to protect them, as well as the dead, against pillage and ill treatment.

They shall see that the burial, whether by land or sea, or cremation of the dead, shall be preceded by a careful examination of the corpse.

Refer to articles 21, 23, 25, 1001 to 1015, and 3573 of the Manual of the Medical Department, United States Navy, 1922, for further instruction and information concerning hospital ships.

Peace Time Activities

The employment and functions of hospital ships may be discussed under the following captions:

A. In times of peace.

B. In times of war.

1. Cruising position.
2. Position or readiness for battle.
3. Tactical employment during battle.
4. Post-battle operations.
5. Tactical employment with amphibious expeditions (to be discussed in a later issue).

The peace-time functioning of an AH may be roughly divided into two classes, (*a*) professional and (*b*) instructional duties in the preparation for war.

"In peace time the duty of a hospital ship is to accompany the fleet on all cruises and to carry out toward that fleet all the duties which are normally ascribed to shore hospital" (McNabb).

"Thus, under peace conditions, a hospital ship is nothing more than a mobile fleet hospital-base, endowed with 'ambulance' facilities for use when circumstances require" (Elder).

In time of peace, as in war, the primary mission of a hospital will be the accommodation of and care for the serious cases from the fleet to which she is attached (Zur Verth).

Since it is highly probable that a naval engagement will occur shortly after the declaration of war, the necessity for the preparedness of existing hospital ships for war condition is quite obvious.

"The hospital ship would further act as a training school for hospital apprentices, and hospital apprentices from battleships should be sent there from time to time for courses of study" (Raison).

"Hospital ships should be maintained in time of peace exactly under the same conditions as in time of war" (President Theodore Roosevelt).

In a report of a joint board—convened by the President to consider medical equipment—appearing in General Orders, No. 84, War Department, May 5, 1906, the indorsement of the Secretary of the Navy states that it is expedient to maintain a hospital ship in commission in time of peace, partly to serve the forces afloat, "*but mainly as a school for surgeons, nurses, and hospital corpsmen in the peculiar duties they would be required to perform in time of war.*"

"The provisions of the Hague Convention must be carefully observed in times of peace as well as in those of belligerency.

"The Navy should be indoctrinated as to the limitations of services of hospital ships."

At the Seventeenth International Medical Congress, London, 1913, Surgeon General Nishi, of the Japanese Navy, strongly urged that only new ships be used for hospital ships, and, notwithstanding the expense, that they be equipped and utilized in time of peace for training purposes.

Nishi tabulates the functions of hospital ships:

1. To accommodate sick and wounded from the forces afloat and from isolated bases.
2. To furnish medical stores to other ships.
3. To provide isolation and treatment for infectious cases.
4. To conduct physical, chemical, and bacteriological examination necessary for clinical and sanitary purposes.

He says that our ideas of hospital ships call for an entirely new type of ship, constructed specially for the purpose, "under the supervision of an expert shipbuilder, with the advice of a medical man having experience of naval requirements. Such ships should be constructed and built in time of peace."

Cruising Position

With a naval expedition starting for an overseas campaign, the cruising position of hospital ships may be divided into two general procedures, viz:

(*a*) Proceed as a component of the main fleet.

(*b*) Proceed singly, independent of other forces.

Each of these methods of disposition of hospital ships has certain military advantages and disadvantages, which depend upon the type of hospital ship under consideration—class A or class B.

This is likewise a question that must be considered hypothetically, since practically no precedent exists to aid in reaching a logical conclusion. The only striking instance of modern hospital ships in time of war accompanying an overseas naval force is the case of the *Orel* and *Kostroma*, accompanying the Russian fleet, and a study of this incident may throw some light upon the most desirable position for hospital ships cruising with the fleet.

In Captain Semenoff's book, "The Reckoning," the author attributes the failure of the Baltic Fleet to reach Vladivostok to the distinctive marking prescribed for hospital ships, which in a dense fog betrayed to a Japanese scouting vessel the presence of the Russians in Tshushima Straits. Togo was up to this point unaware as to whether his adversary would make for Vladivostok by this route or go by La Perouse Strait, to the north of Japan. A few hours more and Togo would have moved his fleet to the north, and this battle would not have taken place on May 27, 1905. The military disadvantage of hospital ships with distinctive markings accompanying the fleet is thus demonstrated, yet a German authority denies the alleged betrayal of the whereabouts of the fleet by the markings of the hospital ships, and concludes by saying, "*It is an old custom, practiced not only in the Russian fleet, to unload the burden of mistakes and failures upon the shoulders of the medical service man.*"

The Japanese auxiliary cruiser *Sadu Maru* captured the two hospital ships before the battle, the *Orel* being detained, while the *Kostroma* was set free and proceeded to Manila, where the surgeons first saw those wounded in the battle of Tshushima, one and a half months later.

The Japanese hospital ships *Saiko Maru* and *Kobe Maru* did not arrive in time for battle, but remained behind, apparently in accordance with a predetermined policy not permitting hospital ships within the combatant area.

U. S. S. *Comfort* and U. S. S. *Mercy* during the period of hostilities proceeded to France under convoy but were camouflaged and under command of a line officer during the voyage.

One of the greatest causes of fallacious deduction is the formulation of a generic rule based upon a specific incident. "It happened once, therefore it will occur again," a result which is possible, but not necessarily probable. Therefore, in making an analysis from a study of the naval engagement at Jutland with a view to the formulation of principles for future application, the fact must be continually borne in mind that Jutland was a specific incident, one battle only, and many of the occurrences were determined by the law of probability and chance, while other results were attributable to local circumstances and combinations of circumstances, some of which may never occur again.

Scientific formulation of principles requires a number of incidents, and the value of any principle established is dependent upon the number of "observed facts."

Following this line of reasoning, from the fact that the Grand Fleet of the British and the High Seas Fleet of the Germans were

not accompanied by hospital ships at this battle, it can not be accepted as one of the principles of naval medical tactics that hospital ships should not accompany a cruising fleet.

The Battle of Jutland was fought with both belligerents near their bases, which rendered it possible for their hospital ships to be available in less than 24 hours after the anticipated action, somewhat similar to the conditions under which the Japanese fought the Battle of Tshushima Straits.

The small squadron of Admiral von Spee, operating at a distance from home ports, was accompanied by a vessel ordered to function as a hospital ship. The *Seydlitz*—not the battle cruiser of the same name—was ordered to accompany this force to act as a hospital ship (Corbett, Naval Operations, vol. 1, p. 433). At the battle of Falkland Islands, when she found that the British ships were nearer than her own, she changed course to avoid them, consequently rendered no medical assistance. Later on, intercepting a message of the British victory, she escaped.

The possibility of a hospital ship accompanying a squadron on a prolonged cruise is not negatived by the occurrences of the World War, "but the chances are against it. It is noteworthy that no such vessel accompanied Admiral Sturdee's squadron, probably on account of the speed and secrecy required, although here he was proceeding to a part of the world ill supplied with hospitals" (19).

If the United States in the next war intends to adopt a naval policy of a watchful defensive, then the construction of hospital ships as a component of the fleet would not be quite so important. A spirit of continued defense is usually the losing policy, so that it is not unreasonable to assume that in the next war the Navy must assume the offensive, and in view of the fact that all probable adversaries are separated from us by the high seas it would appear that plans for the employment of class A hospital ships, of sufficient speed to accompany the fleet to the scene of action, should form a link in our chain of national defense.

As the primary function of hospital ships, class A, is to furnish hospital facilities for the fleet, their presence with the fleet is demanded at all times. In an overseas expedition there are reasons to assume that skirmishes will occur from time to time en route and as a result there will be a constantly accumulating number of battle casualties, in addition to the usual serious cases of diseases and injuries to be found in such a large personnel. These can be transferred during comparatively calm weather, utilizing destroyers or other fast light vessels as ambulance ships to effect this transshipment.

Pryor says that the hospital ship should cruise sufficiently far from the main body and train to avoid injuries in case of an attack upon the train.

They then subject themselves to article 4, second Hague Convention, and could be detained and ordered away by the enemy.

It is highly probable that an overseas naval expedition will be composed of the maximum number of available naval vessels, in which case every precaution against submarine and airplane attacks will be instituted, and the area covered by this large aggregation of vessels will be so extensive that a few hospital ships, painted white and carrying the distinguishing marks required by international conventions, when placed near the center of the cruising formation, should not reveal the movements of the fleet in daylight hours.

The sea space covered by a large naval expedition is so great that the central vessels are beyond the radius of visibility of an observer on an enemy's vessel when in contact with the outer ships of the formation.

During night, however, with all the other ships darkened, the external illumination by hospital ships, endeavoring to denote their neutral character, may jeopardize the secrecy of the naval force to an enemy utilizing aircraft scouting, or when submarines have been able to penetrate the various screens.

The second Hague Convention, fortunately, does not prescribe mandatory directions for night illumination of hospital ships, and rightly leaves this matter to the decision of the force commander—*vide* last paragraph of article 5, HCX.

There are two principal purposes for using coloring and markings in war, viz:

(*a*) Coloring used to deceive the enemy, e. g., camouflage, "war" paint, etc.

(*b*) Coloring used to distinguish the character of military units, e. g., organizational insignia, visual recognition signals, marking of hospital ships, etc.

The question of the recognition of hospital ships at night has not been solved satisfactorily (Zur Verth). The German delegation to the Second Hague Convention suggested as a means to distinguish hospital ships at night that three lights—green, white, and green—be arranged vertically (Pleadwell and Zur Verth). The authorities of this nation also noted that the green stripe, although clearly distinguishable in day time, at night, even when well lighted, is recognizable only a comparatively short distance. Blackwood, in a letter of June 17, 1918, reports that the "present method of carrying out article 5 of the Hague Convention of 1907 is unsatisfactory in that it fails to evenly illuminate the ship's side both in the white and green stripes."

Regarding the use of green for a distinguishing color, Commander H. W. Smith, Medical Corps, United States Navy, has brought out the important point that this color has a low coefficient of reflection, and consequently there are other colors which would be more suitable for the purpose. At night the green color is lost at 100 yards. At 400 yards the outline of the green stripe is lost, and at 1,000 yards it is "impossible to distinguish the mass of the hull or to even discern the silhouette, so that the spatial relation of the illuminated area to the rest of the ship can no longer be perceived. The appearance is that of a brightly lighted river steamer" (Bureau files). Varying the angle of incidence of the illumination did not improve matters.

According to the correspondence on file in this bureau, illuminated red lights, arranged in form of a cross on the smoke stack, have interfered with the navigation of other ships, and for this reason the use of the same was abandoned, and the C-in-C of the Atlantic Fleet on June 27, 1918, reports removal of the illuminated red crosses on the smoke pipe of the *Solace*, the reason being the possible confusion of these with running lights.

Holcomb states that he believes "a hospital ship should proceed independently, and in the rear of the fleet. She can not know the moment of contact of the fleet with the enemy. She must depend upon the Commander of the Train for orders, and they must and will emanate from him to determine her movements. As a question of policy it would seem that she should base somewhere within a safe position within the zone of action. After an action the fleet will probably be as much on the move as it was before the action, and the direction of its movement would be either to return to its base or to continue on with a definite mission. All of this means that the first steps of human salvage would be undertaken before the hospital ship could arrive upon the battle area. She certainly could perform no neutral function there until the battle was over—that much it seems to me ought to be clear to anyone."

The presence of medical transports—excepting the small ambulance ships referred to as rescue ships—is not required for duty with the fleet in cruising formation, and it would appear advisable that this class proceed singly, displaying their distinguishing marks both by day and night. The necessary precaution should be taken that the course specified for the vessels to follow should be one that will reveal—as little as possible—the route and destination of the main forces.

It should be quite obvious that this proposed disposition is not intended to be adaptable to meet all special situations which may arise and the precise cruising position of hospital ships is at all times a matter for decision by the commander in chief of the force;

consequently these expressions are merely intended to put forth the medical viewpoint of this question.

As a general doctrine, the following principles of medical tactics may be established:

Class A hospital ships should proceed with the fleet, and be stationed in a cruising position near the center of the formation, displaying their conventional marking in the daytime, but avoiding all external illuminations at night. Class B vessels should proceed singly to the destination, displaying the distinguishing markings day and night.

In military parlance, mobility of a unit or organization is rather loosely used. It would appear that active and passive motion should be differentiated by employing the words motility and mobility to effect this distinction.

The term "motility" has never been used, so far as can be ascertained, in military literature, with one recent exception when Sutton employs it in his book on hospital ships.

The term "maneuverability" is sometimes used as synonymous with "mobility" but the former term is really broader in its scope.

The following definitions are offered.

Maneuverability of a military element comprises the motility and the mobility of that unit.

Motility is the *power* of a military unit to change its position or formation in obedience to orders, commands, or other agents originating *within* the organization; active motion.

Mobility is *a state* or a condition of a military unit which permits its position or formation to be changed in obedience to orders, commands, or other agents originating from *without* the organization; passive motion; movable.

Motility is the power of *active motion; spontaneous motion*. A high degree of motility implies something more than mere *speed*, as speed denotes the distance traveled in a given period of time with some other object as a means of comparison. Thus we have speed through the water and speed over ground, or speed through the air. For example, the motility of a submarine, or a division of submarines, comprises the rapidity of submerging or emerging, speed, tactical radius, and rate of increase of speed.

There are possible occasions where battleships, due to an excellent system of communication, may possess greater *mobility* than a destroyer.

Thus motility implies *independent action*, whereas mobility is more apt to imply coordinate movements. The "Independent Action" of cavalry is an example of motility, but the movements of

the divisional cavalry regiment would be more likely to be an example of mobility.

The above discussion is, however, a digression from the topic.

Position of Readiness

The historical instances of the position of hospital ships in the prebattle phase, or when battle may be imminent, will be cited as a basis for the establishment of this principle of naval medical tactics.

In the Russo-Japanese War, the Japanese hospital ships were always stationed at the bases during the prebattle phase; the Russian hospital ships accompanied the squadron, which, unfortunately, had little opportunity of availing itself of their services.

In September, 1914, when the German fleet took the high seas, the hospital ships advanced with the fleet and assumed a position of readiness under the protection of islands lying off the coast.

When any movement was undertaken by the German fleet, as in the expedition of January 24, the hospital and ambulance ships were ordered out, and usually cruised in the vicinity of Helgoland within easy call by radio if needed.

During the entire period of the World War, the German hospital ship *Sierra Ventana* remained in a state of readiness with banked fires, ready to put to sea within four hours' notice. She maintained at least 60 per cent of her bed capacity available constantly for battle casualties.

In the first few months of the war the various hospital ships of the British Navy were distributed at the "different bases and remained there for lengthy periods until the congestion of the wards and the emptiness of the coal bunkers made it necessary for the ship to make a passage to a port where the patients could be landed and thence conveyed to the large naval hospitals by ambulance train. By the year 1916, however, all the ships in northern waters were working according to definite schedule, each ship doing a tour of duty which lasted three months, one month being spent at each of the principal bases, ship relieving ship in rotation. At the end of her three months' tour each hospital ship went into dock, landed her patients and had a week or 10 days for coaling ship and carrying out necessary repairs. As there were four ships employed it might be said that at any given time there would be one hospital ship at each base and one off duty in dock" (Taylor) (23).

"The fairly widespread conclusion of those qualified to speak with any authority on the subject is that in time of war the function of the hospital ship remains about the same as in peace, and that, contrary to general belief, 'she can not be used to remove the wounded from ships coming out of action; nor can she at any time

be anywhere in the neighborhood of action, or of any elements of the fleet * * * preparing for such action.' A fleet maneuvering preliminary to action must do so with the greatest secrecy. Just the opposite obtains in the case of the hospital ship. She must at all times, day and night, advertise her identity to maintain her right to protection under the Hague Convention" (Bell) (24).

A message was sent by the German commander in chief on May 31—when the Battle of Jutland was imminent—to the hospital ships' commander, to "Hold hospital ships at their anchorage." This is the only message relating to hospital ships discoverable in the German official dispatches of the Battle of Jutland.

The best position of readiness for hospital ships during a fleet action would depend largely upon the site of battle. The proper location under certain conditions would be near a base similar to the position of the German and British hospital ships during the Battle of Jutland. If it is not practicable to assume this position, then the hospital ship should "take a position at such a distance as would not interfere with the line of maneuver or retreat, and its position should be so separated from combatant ships that its status as a hospital ship can be distinctly recognized. When conditions permit, the hospital ship should then proceed to the scene of action (Freeman—letter dated March 19, 1924, bureau's files).

The mission of the fleet hospital ship is such that she would be with the fleet at all times in capacity as a general hospital. I do not mean that she should be in the battle line any more than I believe that the base hospital of an army should be on the firing line. This of course means she would be in the rear, rather than in the van of any fleet, where scouting or any unneutral charges could *not* be made. She must not be looked upon as an ambulance ship or for ambulance work, as this mission can be easily discharged by ships of less elaborate equipment. The ambulance work is a secondary consideration, rescue work can be done by such ships as destroyers during or after battle. The actual presence of the hospital ship during battle would only invite her destruction. To be of use her station should be known and she should know the station of the fleet and each should use equal exertions to make it possible to discharge to the full the duties of her mission. Her neutral and her humanitarian mission should always be respected by her fleet, else she will always be under suspicion by the belligerent (Holcomb).

The employment of the hospital ship will vary according to the way the war is conducted. It may be kept on the home coast to bring help to those injured by mines or torpedoes; or it may accompany a squadron to an advanced base or it may be employed as a transport for wounded to the home base hospitals, or it may serve as a mobile floating hospital. The theatre of battle is rarely on the high seas; usually it is near a place of support (base) where the hospital ship can remain during action. After the battle of Skagerrak by far the largest number of wounded were put ashore directly from the warships at home ports (Zur Verth).

The conditions under which naval engagements take place may be summed up under the following categories:

Special situation A—Naval action in proximity to home bases.—In view of the risk from accidental damage to hospital ships from mines, torpedoes, airplane bombs, and stray shots, it would appear advisable for class A and class B hospital ships (excepting the proposed "rescue" ships) to remain at near-by bases, similar to the position assumed by the British and German hospital ships during the Battle of Jutland.

Special situation B—Naval action at a distance from naval bases.—As mentioned elsewhere, the class A ships are needed shortly after action, hence they should assume a position of readiness as near the scene of action as practicable. Class B vessels are designed to function more as transports, hence their presence immediately after action is not so urgent, and it is believed that they should remain at a greater distance—as a matter of precaution—than class A ships.

If a special type of hospital ship is provided as rescue vessels, they should incur a certain proportion of combatant risk by accompanying the fleet into action.

Tactical Employment of Hospital Ships During Battle

In approaching a discussion of the proper disposition and tactical employment of hospital ships during battle, it may be stated that four methods serve as guides in arriving at some conclusions of a standard doctrine of their use under such conditions, viz:

(*a*) A theoretical consideration of the subject.

(*b*) A study of historical instances.

(*c*) The chart maneuver and tactical board.

(*d*) Testing out their utility during the annual fleet maneuvers held under simulated battle conditions.

A theoretical consideration of this subject leads to few satisfactory results, as the opponents and proponents of a specific method of their employment appear equally convinced and satisfied with the results of their own line of reasoning while a study of the historical incidents of the employment of hospital ships during battle likewise furnished little or no assistance in the formulation of doctrinal methods because the number of such instances are too few to warrant satisfactory deductions.

The Italian hospital ship, mounting two guns, such armament being permissible in those days, remained with Admiral Albini's division, and took no part in the Battle of Lissa, although she received the wounded from a landing party previously sent ashore. It was the large loss from drowning in this battle which was largely responsible for the agitation demanding the application of immunities, then granted for the medical department of land forces, to the medical and hospital services afloat.

The Japanese hospital ships—*Saiko Maru* and *Kobe Maru*—failed to arrive in time for the Tsushima engagement; this Braisted regards as "unfortunate," as they might have rendered very useful service in the rescue of at least many Russian wounded. For some reason these two ships remained on the Korean coast until too late to participate actively in the action. There were no hospital ships present at the Battle of Jutland.

It would appear that the game board and the fleet maneuver should supply data to serve as a basis in the formulation of a standard method of employment of hospital ships during a naval engagement.

The majority of writers, however, are inclined to believe that the hospital ship can be of little or no military service during action, and such views will be quoted first, followed by arguments tending to suggest that a special type of fast ambulance ships, equipped as rescue vessels, may be of the utmost military value, or rather that the probability of this special type of hospital ship being utilizable in rescue work is so great that provisional plans should be made to include their use.

Surg. Gen. H. D. Rolleston, states that hospital ships can not accompany the fleet in action because:

1. Too slow,
2. Unable to transfer wounded except in smooth sea,
3. The transfer of wounded would oblige battleship to heave to and thus expose it to a hostile attack.

He believes hospital ships may serve in intervals during action.

The hospital ship, as a rule, has no place in battle, but should keep such a position as will insure its safety, and in no wise compromise its neutrality.

Carpenter says:

> In view of the great range of modern guns it is doubtful if the hospital ship can be near enough to help the crew of a sinking or burning ship without running a grave risk of being disabled or sent to the bottom. The rapidity with which Beatty's ships sunk demonstrated how hopeless such a rescue may be. Lissa, Yulu, Tsushima, and Jutland indicate that the greatest mortality will be found from drowning. The duty of rescue of men from sinking or burning ships must be left to vessels of war, as shown during the battles of Jutland, Straits of Tsushima, and Santiago. With the hospital ship at a distance from the main body of the fighting ships, before contact with the enemy, communication by wireless might reveal the general location of the fleet. The distinctive painting of the hospital ship by day, and the necessity of screening lights at night raise the question of advisability of being in formation at all. As to the proximity after action, it is again impossible to decide except in very general terms. A long running fight may make it impossible for the hospital ship to be utilized for hours, if not days. With action pending it will be impossible to assign a position to a hospital ship that will

enable it to be at one and the same time out of danger and yet within reach of a ship requiring its services. The position with the train in cruising formation and during action, or at a base if adjacent, seems more advisable.

Mr. G. H. Makins regards the employment of hospital ships as rescue ships during battle as "chimerical." He says, "from the great carrying power of modern artillery, it (the hospital ship) will never be in a position to render immediate succor to the company of a wrecked vessel without running the grave risk of being put *hors de combat* or sunk by a shell, besides it has been demonstrated that the time taken by a ship of war, seriously damaged, to sink is but a question of a few moments; further to exercise this function of life saving will require such an equipment of launches and apparatus that the efficiency of the hospital ship in other respects will be greatly compromised."

According to McNabb, the only pretext which might induce a hospital ship to approach the fighting zone during a naval engagement "would be found in the desire to assist a battleship or cruiser which had hauled out of line owing to damage and was in danger of foundering."

In a naval engagement, whether "of a running nature or of opposing squadrons circling each other, all that a hospital ship could do would be to keep as clear as possible without losing touch. Should a ship become disabled, the hospital ship should approach and take the wounded on board" (Handyside) (25).

"The presence of a hospital ship at or in the vicinity of a naval engagement may be looked upon as being so impracticable and unlikely to occur under average conditions—if such term can be applied to naval engagements—as to need no consideration."

The director general of the British Naval Medical Service believes that the "indiscriminate sowing of mines and torpedoing of ships by submarines practically eliminates the possibility of any transshipment except in a protected area" (19). (In event of a battle on the high seas can this protected area be formed by a screen of destroyers and mine sweepers?—W. L. M.) This authority states that further developments in naval warfare, with special reference to improvement in the aerial branch of the service, will likely diminish rather than increase the usefulness of hospital vessels at the scene of naval action.

"When the time has come to accept battle, the hospital ship can do no better than to remain within easy communication with the fleet but outside the range of hostile scouts and destroyers. If she ventures too far, she might find herself the innocent bystander in the midst of gunfire. Her assistance is practically negligibie until the outcome of the engagement is decided. Even in case of victory

her operations will depend upon the amount of damage suffered by our ships, since the military requirements will be paramount to humanitarian" (Straeten).

It is most likely, as past experience has shown, that the relief rendered to sinking and burning ships will be accomplished by the combatant vessels themselves, as was the case at Lissa and the battle of the Sea of Japan (Wise) (26).

Pannet opposes the attempted employment of hospital ships in battle, as he believes that it is wrong in principle.

It soon became evident that any preconceived ideas of hospital ships proceeding to scene of an action had to be discarded. Apart from the difficulties of transporting wounded men from the fighting ships in bad weather at sea, it was obvious that conditions of modern naval warfare preclude these ships from remaining with their engines stopped without running grave risk of being torpedoed by submarines (Lomas) (27).

In view of the weight of opinions that hospital ships can be of little military value during a battle, the following principle of medical tactics is proposed—*hospital ships, Class A and Class B (excepting the proposed rescue ship) should remain without the radius of action.*

Hospital ship as "rescue" vessel.—Although there is not enough evidence to warrant the expression of a definite opinion, I am inclined to believe that the arguments are sufficiently strong to warrant planning upon a special type of hospital ship—converted obsolete destroyers—equipped as rescue ships and for these ships to incur some of the risks of accidental damage in action in order to attempt to succor the crews of burning and sinking vessels, and to render such other unforeseen service as may arise during a naval engagement.

The only type of vessel which could possibly be of any use on the scene of a recent action might be termed a "Rescue" ship. For this purpose she should be duly registered under the Geneva Convention, and be a fast, shallow-draft vessel of about 500 tons, with unencumbered decks and low freeboard. In addition to medical staff and first-aid equipment, she should be fitted with appliances for enabling survivors to be easily and quickly picked up out of the water and off wreckage and flotsam floating about, and thence rapidly conveyed to port. A flotilla of obsolete destroyers might conceivably be so fitted and used. An ordinary hospital ship of the usual type is too big and unwieldy in addition to being too slow for this class of medical salvage work (Zur Verth).

The steam yacht *Deerhound*—flying the British flag—is a striking historical illustration of the employment of small vessels as rescue ships. This small craft rescued the survivors of the Confederate ship *Alabama* which was sunk by the Federal cruiser *Kearsarge* on June 19, 1864.

Captain Semmes of the *Alabama*, finding his vessel sinking, gallantly placed his wounded into the two remaining boats, and left the uninjured officers and men to their fate. Fortunately, Mr. Lancaster, owner of the *Deerhound*, was able to rescue Semmes and a greater part of the crew, and this little vessel steamed away with the survivors, creating an international situation which is now covered by the Hague Convention. Mr. Lancaster defended his action in a letter of June 27, 1864.

Captain Winslow declares that "the reason he did not pursue the *Deerhound*, or fire into her, was that he could not believe at the time that any one carrying the flag of the Royal yacht squadron could act so dishonorable a part as to carry off the prisoners whom he had requested him to save from feelings of humanity." I was not aware then, and I am not aware now, that the men whom I saved were, or ever had been, his prisoners. Whether any of the circumstances which had preceded the sinking of the *Alabama* constituted them prisoners was a question that never came under my consideration, and one which I am not disposed to discuss even now. I can only say that it is a new doctrine to me, that when one ship sinks another in warfare the crew of the sunken ship are debarred from swimming for their lives and seeking refuge wherever they can find it, and it is a doctrine which I shall not accept unless it is backed by better authority than that of the master of the *Kearsarge*. What Captain Winslow's notion of humanity may be is a point beyond my knowledge, but I have good reason for believing that not many members of the Royal yacht squadron would, from "motives of humanity," have taken Captain Semmes from the water in order to give him up to the tender mercies of Captain Winslow and his compatriots (28).

An authority on naval matters has made the remark that Great Britain suffered more from the loss of about 7,000 trained and experienced officers and men drowned during the battle of Jutland than from the material loss of three large battle cruisers and many light craft. In view of the large losses from drowning, the military importance of hospital ships to specialize in rescue work should be quite evident. It may be argued that combatant ships should accept this responsibility, yet naval actions comprise the most crucial period of a naval campaign when fighting vessels are in the greatest demand for the purposes for which they were designed. Furthermore, it is conceivable that the presence of a crew of shipwrecked and wounded, when brought aboard a combatant ship during the heat of the battle, would so upset the internal organization of the receiving vessel that its military function would be seriously impaired. The conservation of personnel is the primary mission of a medical department and all things being equal, it is believed that to this branch of the service the responsibility of rescue should be delegated.

The Germans throughout the battle of Jutland paid great attention to rescuing the crews of their disabled ships (Frost). In the midst of the enemy fire, the German ship *V-26* went alongside and

rescued the entire crew of the *V–27* and the greater part of the crew of the *V–29*.

There is reason to believe that obsolete torpedo boats, equipped primarily to rescue personnel, accompanied the German High Sea Fleet, and at least in one instance this type of vessel saved men of their adversary's fleet. (*Vide* Part 1 of this article, p. 265.)

The relative immunity obtained by having hospital ships, instead of combatant vessels, engage in the rescue of the personnel of sinking and burning vessels would result in much greater percentages of successful attempts at rescue, thus compensating for the extremely small loss of naval force, which would not occur in case the obsolete destroyers were used as combatant vessels with a dual mission. Furthermore, as has been stated elsewhere, there is a need for exactly this type of hospital ship to function in the interim as an intermediate ambulance ship.

The argument is naturally advanced that hospital ships serving as rescue ships would be subjected to the fire of the enemy, yet the results of the battle of Jutland show conclusively that there is great difficulty in sinking light vessels in a daylight action. For example, a large number of German battleships fired at four light cruisers of the Second Light Cruiser Squadron for nearly one hour, yet not a hit was scored, and for eight minutes the German battleships—second line—fired at the low ranges of 5,200 to 8,000 yards at three vessels of the Fourth Light Cruiser Squadron, without making a hit, although the first salvo was a "straddle."

With 16 battleships formed in four divisions, steaming in line of column, with a distance between ships of 500 yards and distance between divisions of 750 yards, the space from the battleship on the extreme right to the one on the extreme left will be 8,250 yards.

Assuming that rescue ships of 30 knots speed were equally disposed, one on each wing, 2,000 yards rearwards from the flanking ships, this would place the two central ships in the battleship formation approximately 5,000 yards from the rescue vessel situated on the wings. With the column of battleships advancing, a disabled and sinking ship would be rapidly left behind, which causes her to be located at a reasonably safe position for the life-saving work of the rescue ships. The ship could be reached by the rescue ships in approximately an average of 20 minutes, affording sufficient time for the rescue ship to reach the scene of the sinking and save a greater or less proportion of the complement from drowning.

Should the battleship formation be approaching the enemy in line of bearing, the position of a sinking ship dropping out of line would not be quite so favorable for rescue work. Should the fleet be retreating from the enemy, a ship falling out of line will cause the

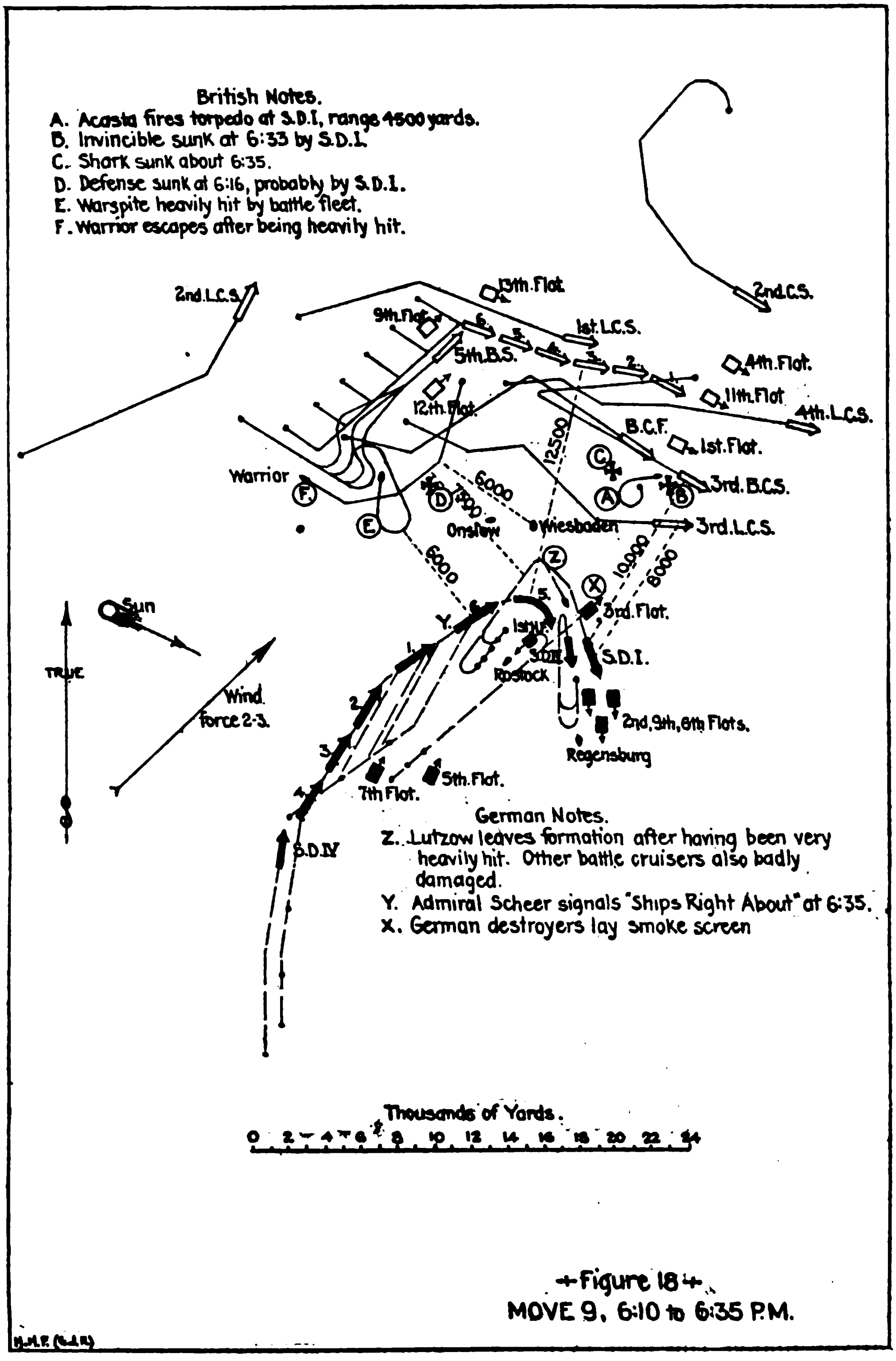


Fig. 1.—Battle of Jutland. German light cruiser *Wiesbaden* lying dead in water under concentrated fire of British. Illustrates difficulty of rescue hospital ships functioning to relieve vessels in this position. A swift hospital ship would have a reasonable chance of rescuing under fire a portion of the crew. (Diagram by Lieut. Commander H. H. Frost, U. S. Navy)

gun range to close rapidly, so as to prevent any extensive use of rescue ships.

The expense involved in converting and equipping obsolete destroyers as rescue hospital ships is so comparatively small, when the chances of their value in saving several hundred trained and experienced officers and men are considered, that it is believed plans should be made for at least four rescue ships to accompany the fleet into action.

In the evolutions of the hospital ships there is a certain danger of blanketing the fire, but this effect would be momentary, and applies no more to rescue hospital ships than to other light vessels.

While the naval forces are trying out various mechanical processes and tactical schemes in their annual maneuvers, it would appear a profitable project to the naval service to assign two or more destroyers as hospital rescue ships and test their value by having them maneuver for the hypothetical rescue of the crew from certain capital vessels of the fleet supposed to be sinking.

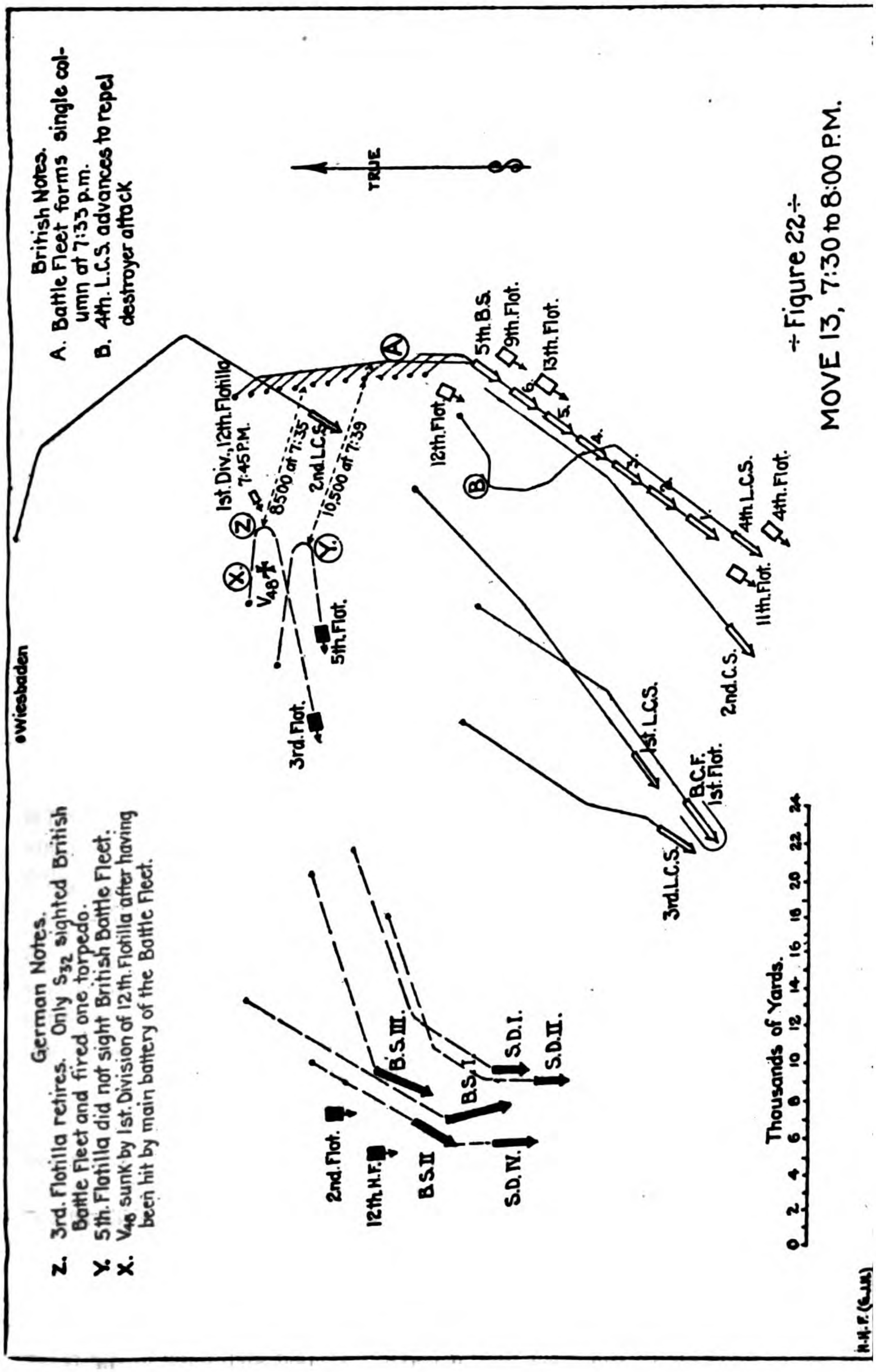
Another important fact that should be borne in mind is that modern naval engagements are fought with great distances between the opposing fleets, which causes the trajectory of projectiles to be so elevated that a vessel in the line of fire will not necessarily be hit, as would be the case in shorter ranges when the trajectory is more apt to parallel the earth's surface.

Life-saving equipment.—A consideration of the subject of rescue ships involves a discussion of life-saving equipment for hospital ships, and this has been divided into (*a*) appliances for use in saving the personnel of the hospital ship in case of its sinking or other accidents, and (*b*) appliances intended for salvaging crews of other ships. The first class of devices should be the same as that of any other vessel. The apparatus which enables the hospital ship to specialize in the mission of conservation of life will be given special consideration in this discussion. Rescue gear may also be divided into (*a*) individual rescue apparatus and (*b*) collective rescue apparatus.

The swimming vest, floating jacket, or "life preserver" is an illustration of the first class. One of these should be provided for each member of the crew. These should be stored on deck, ready for use, accessible, and protected from the weather. Bed patients should keep their "preserver" near the bed. White cork covered by heavy canvas makes the best type.

Kapok clothes may be used, care being taken to prevent damage to them when not in use. This material is highly inflammable.

Life buoys composed of cork or kapok should hang near the rail, one every 10 feet, and a certain percentage should be fitted



÷ Figure 22 ÷
MOVE 13, 7:30 to 8:00 P.M.

with automatic light flares. Kapok mattresses were used in the hammocks by the Russians in the Russo-Japanese War, and these articles made an excellent improvised life preserver to which many a Russian sailor owes his rescue from drowning.

The group rescue apparatus includes mattresses, floats, rafts, half floats, lifeboats.

Rope ladders should be provided so that a person standing on the footboard can draw in to the foot of the ladder a drowning person and can lift him more readily from water for conveyance to the deck above.

"Rescue baskets" are built like a large bird cage, with a bottom of strong hemp-woven cloth, attached to the inner side of a large cork ring sewed up in heavy canvas. The side walls are made of rope ladders, leaving spaces large enough for a man to enter the side of the basket. The rescue basket can be let down into the water and hoisted by a crane. (Fig. 4.)

Wiemain has constructed a double hook or a forceps which automatically closes when placed around the drowning man and pulled.

A line fitted with loops and straps may be rigged around the ship at the water line to which those in danger of drowning may cling.

The rescue equipment of small boats includes straps, rescue hooks, and signal devices, provisions, water, restoratives, etc.

Credit is acknowledged to Chief Pharmacist Mate A. V. Steinkraus, Fleet Naval Reserve, for the translation and abstraction of the following data from the Archiv für Rettungswesen (29):

According to Schulte, the German Navy, during peacetime, loses about 1.43 per 1,000, or 1 in 700, personnel through drowning, by shipwrecks, suicides, and individual accidents. Schulte's research covers the period from 1883 to 1908. The total number of deaths due to drowning during this time was 926.

During wartime the number is much greater, as is evidenced by the World War, of which the following two incidents only are mentioned: Coronel, November 1, 1914, and Falkland Islands, December 8, 1914. In the first battle, almost the entire English strength of 1,440 men lost their lives through drowning, while in the latter, the same fate befell the Germans. A total of 2,000 men were lost through drowning in these two battles alone.

These few incidents may suffice to indicate the great field open for the invention of material and devices that can be used to prevent drowning.

In numerous accidents, especially to individuals who are accidentally precipitated into the water, death may be due to shock, but, in the Navy, death in the water in most cases is from suffocation. About half to three-fourths of the seafaring people of the world can swim. Swimming requires movement, which in cold water is not desired, as every movement exposes new surfaces, and death may ensue from exposure. In heavy seas the danger, even to a good swimmer, is opening the mouth and taking in water instead of air. He should try to keep above the crest of the wave. A good swimmer under favorable circumstances can keep afloat in the water for hours, while under adverse conditions drowning may ensue in a few minutes.

FIG. 3.—MEDICAL STAFF OF THE HOSPITAL SHIP "RED ROVER"

Photograph taken during the American Civil War. Reproduced from Photographic History of the Civil War, by permission of The Review of Reviews Company

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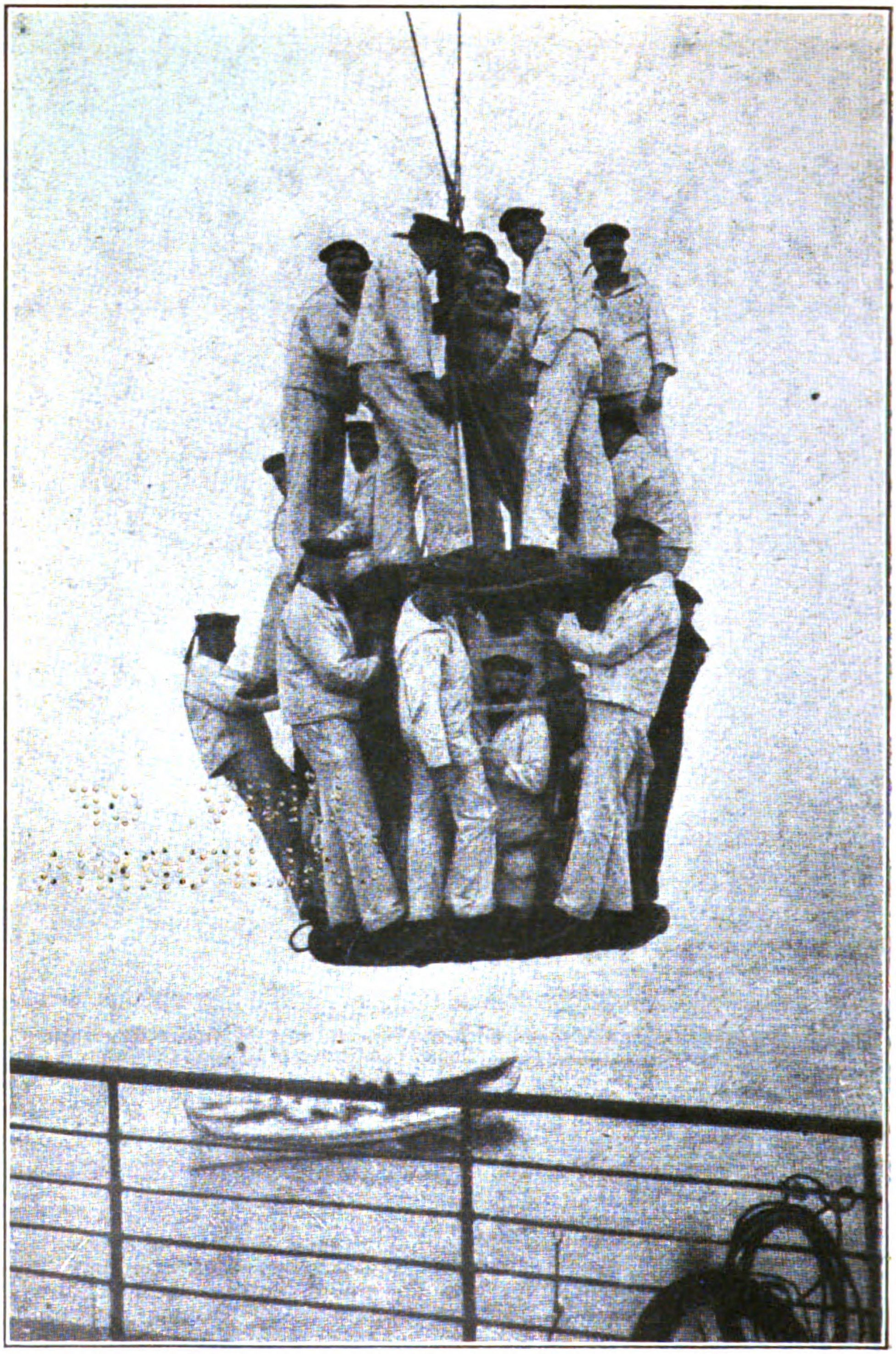

FIG. 4.—RESCUE BASKET FOR THE COLLECTIVE RESCUE OF THOSE IN DANGER OF DROWNING

Reproduced by permission, from Das Lazarettschiff

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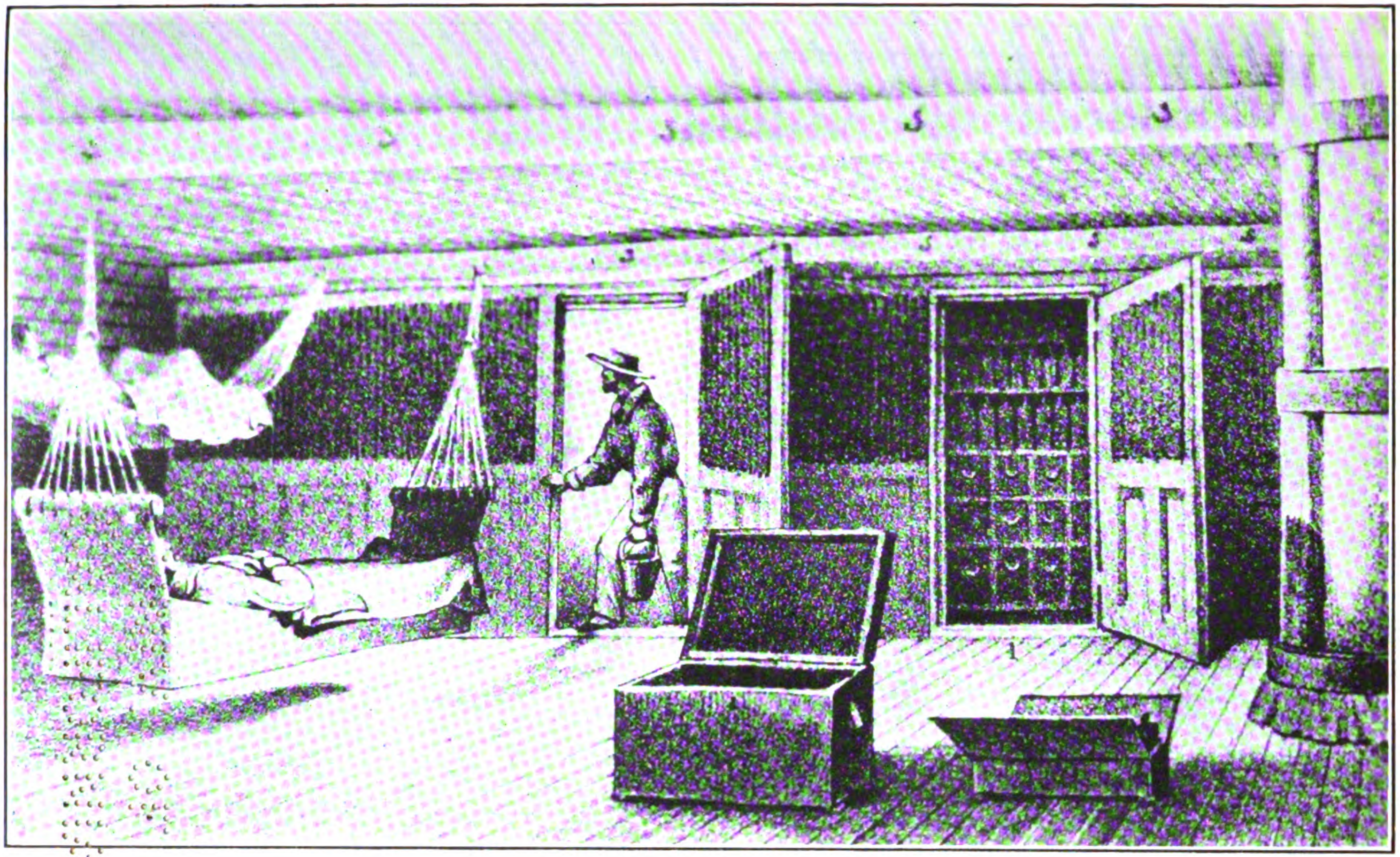

FIG. 5.—SICK BAY OF AN AMERICAN NAVAL VESSEL, ABOUT 1850

Note the canvas hospital cot and type of hammock in use at that time. After Horner

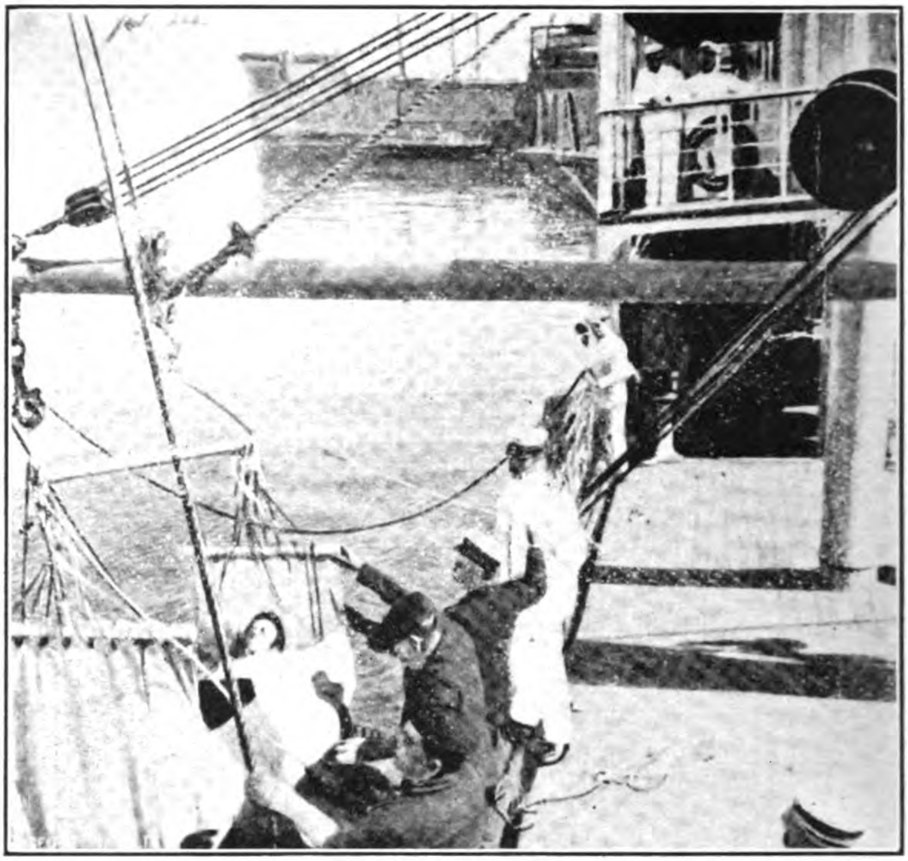

FIG. 6.—DEBARKING A PATIENT FROM AN ITALIAN HOSPITAL SHIP. PATIENT IS SUSPENDED IN A CANVAS COT

Note the "cot pole"

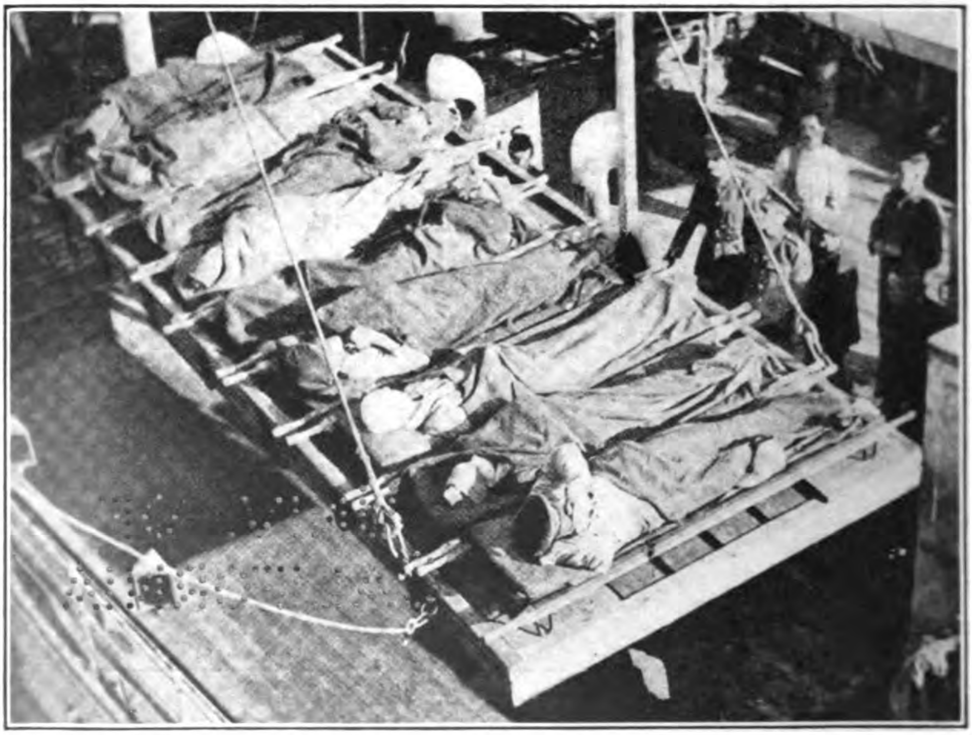

FIG. 7.—HOISTING BRITISH STRETCHER CASES. COLLECTIVE METHOD OF DEBARKATION

Photograph by Underwood and Underwood

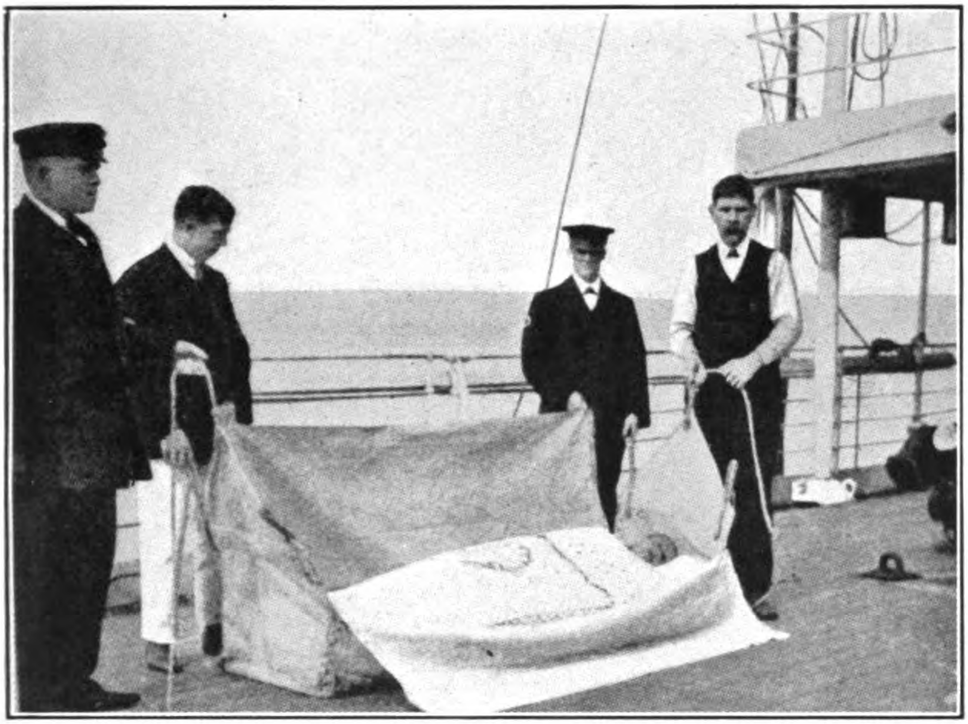

FIG. 8.—CANVAS COT USED BY BRITISH NAVY

From "Naval Hospital Ships" by Sutton

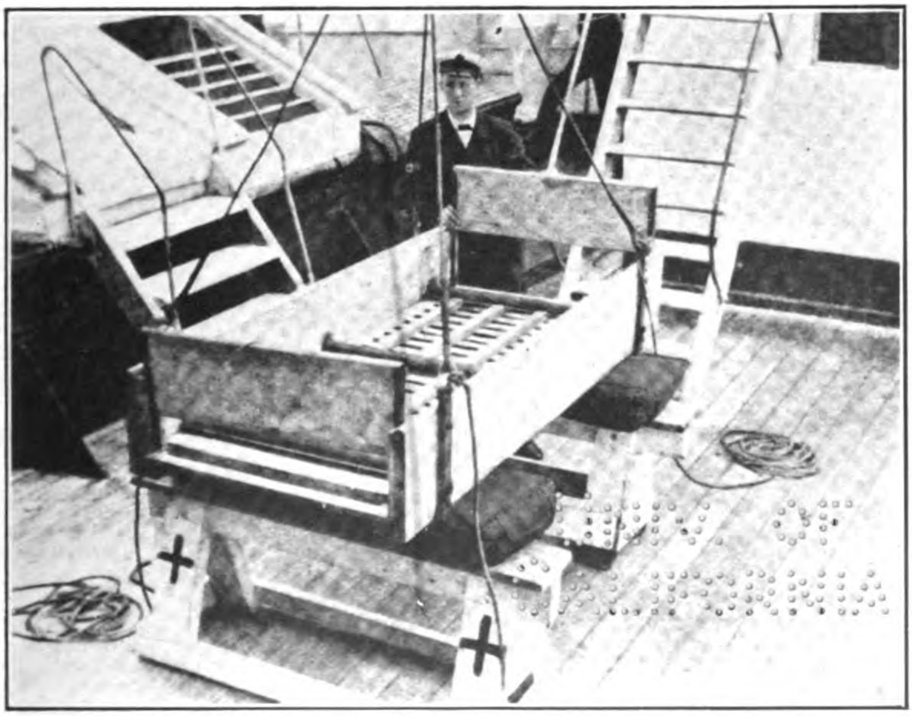

FIG. 9.—COT CARRIER USED BY BRITISH HOSPITAL SHIPS FOR HOISTING PATIENTS

From "Naval Hospital Ships" by Sutton

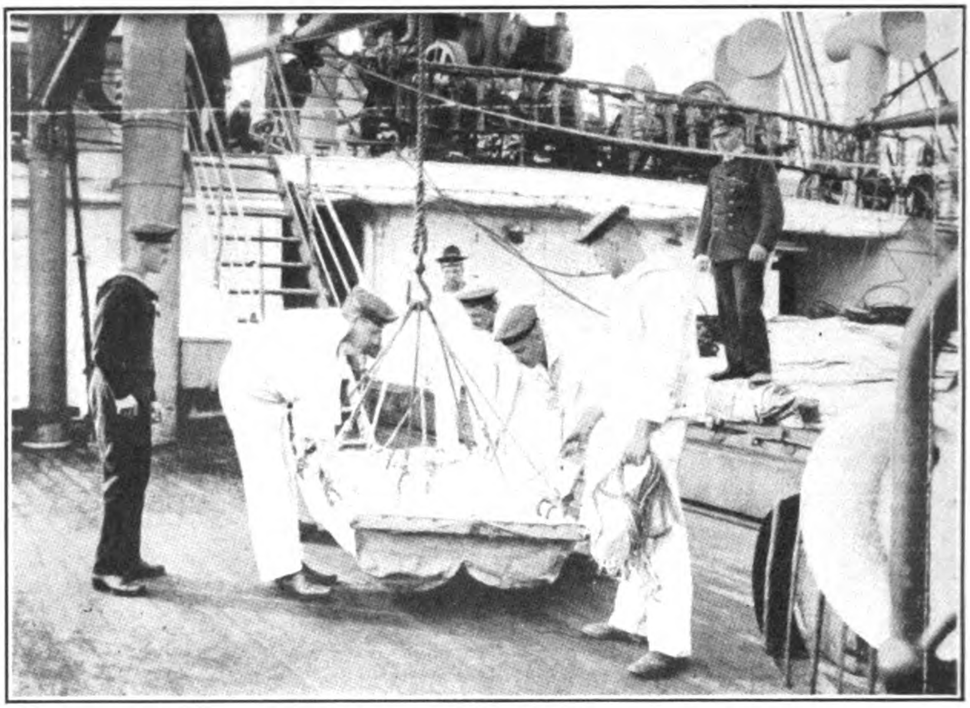

FIG. 10.—THE DOUBLE LITTER CARRIER USED IN THE WORLD WAR BY THE GERMAN NAVY

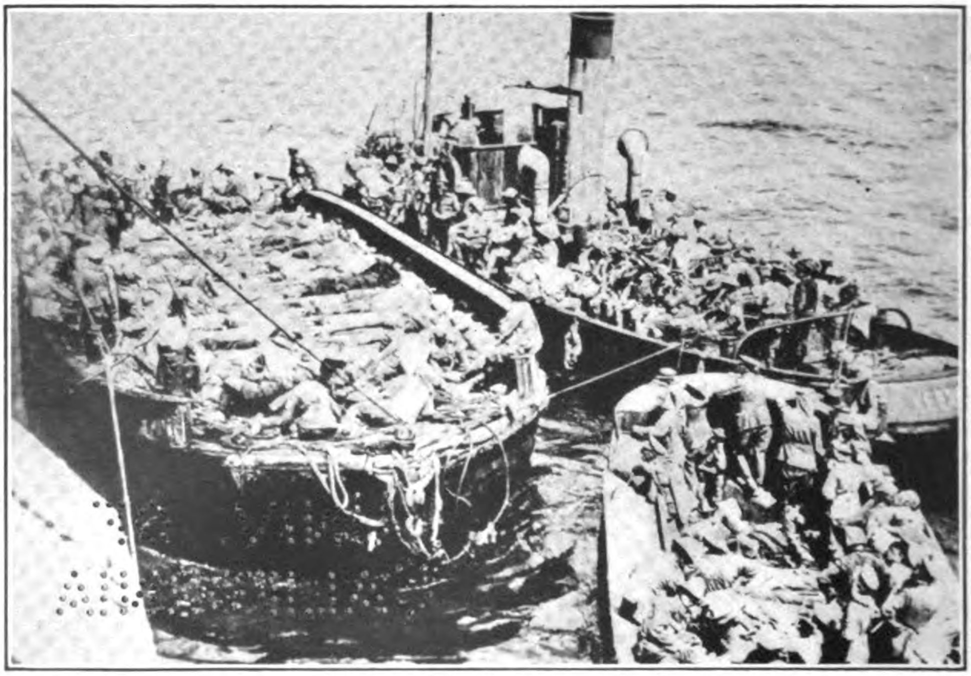

FIG. 11.—BARGES OF WOUNDED ALONGSIDE BRITISH HOSPITAL SHIPS WAITING TO CARRY THE PATIENTS TO BASE HOSPITAL PORTS

Reproduced by permission, from The Red Cross Magazine

To those in the water who are in possession of some life-saving apparatus, the danger lies in exposure. Death through starvation and thirst is comparatively rare.

Below is a comparative table of materials used in life-saving devices:

Characteristics	Air	Kapok	Cork	Cell gum
Safe or unsafe	Not safe	Not altogether safe.	Safe	Safe.
Always usable	No	Yes	Yes	Yes.
Protection	None	Good	Little	Medium.
Durability	do	Medium	Good	Not yet determined.
Cost	Cheap	Cheap	Cheap	Not known.
Space saving	Yes	Medium	Little	Medium.

Everyone should be instructed as to his conduct when precipitated into the water, and the following is a general outline of the instruction which should be given, according to Zur Verth:

1. Instruct yourself in the use of life-saving apparatus so that in case of necessity you may be familiar with it.
2. When in swimming use life-saving devices so that you may become thoroughly familiar with them.
3. When putting on the swimming jacket, fasten it thoroughly around the chest and abdomen, because in the water it has a tendency to push upward.
4. If you have time in case of shipwreck, endeavor to secure a small flask of water.
5. When precipitated into the water every effort should be made to save your energy and preserve warmth.
6. In case you have no swimming jacket, try to obtain something that will keep you afloat, even though you can swim.
7. Make every effort to get away from the sinking ship.
8. If you are in possession of some life-saving apparatus do not take off your clothing. So long as air remains in your clothing it acts as a protection against cold and is also buoyant.
9. The less movement you make in the water, the longer the air will remain in your clothing.
10. Floats are excellent, but do not forsake the swimming jackets or life buoys, as they have been tried and will keep you afloat.
11. Floats are good as long as they are not overloaded. Keep on a lookout for some other apparatus.
12. If it has been impossible to obtain some life-saving apparatus, keep afloat by treading water. Treading water is the least tiring of the swimming movements.
13. Try not to swim toward a lifeboat when you see one coming but save your energy. Wait until it reaches you.

The Functions of the Hospital Ships After Battle

The primary function of hospital ships after battle is to relieve the fighting ships of the persons wounded in action, in order that efficiency of the fleet may be correspondingly increased for a renewal of the engagement.

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At the Battle of the Yalu River, the Japanese fleet was accompanied by a splendid fast hospital ship—formerly a passenger vessel of the Nippon Yusen Kaisha (Japanese Steamship Co.). At the close of the engagement, the wounded were transferred from combatant ships to this vessel, leaving the fleet free to reengage the Chinese forces in the morning, as Admiral Ito expected to do at Wei-hai-Wei—without being embarrassed by the presence of sick and dying men.

It was the policy of the Japanese, both on land and sea, to remove out of sight as soon as possible the dead and wounded, the presence of which tended to depress or discourage the fighting troops. During the Battle of Yalu, the Japanese cruiser *Hiyei*, after suffering great losses, managed to transfer the wounded by small boats to a medical transport, and resumed her position in the main body, using her guns until the last (James Creelman, reported by Stitt in Mil. Surg. 5:322, 1895).

The character of the naval operations in the recent war rendered the services of the German class "A" hospital ships "superfluous," and all but one—the *Sierra Ventana*—were taken off active service, their places being filled by medical transports. This vessel, however, after the Battle of Jutland, accommodated a large number of shipwrecked persons, cared for 168 wounded, and also evacuated 76 seriously wounded from the hospital at Wilhelmshaven. These patients were retained 14 days and then transferred to a naval hospital.

Rolleston, several years ago, suggested that hospital ships should act as clearing stations in the postaction phase, and in this capacity the British hospital ships functioned after the Battle of Jutland.

> In regard to the postbattle period and accepting the fact that the surviving fighting ships must return to a base for military reasons, coal, ammunition, stores, etc., the function of a hospital ship changes from a "base hospital" to that of a "clearing station."
>
> To what extent a hospital ship would be of use afterwards on the site of an action is also very problematical. First of all, it may be stated that except under most unusually favorable conditions of weather, which certainly can not be relied upon to obtain, the transfer of wounded from a fighting ship to the hospital ship by boats in an open sea is so slow, and attended by such difficulty as to make it impossible on any extensive scale. Likewise, all schemes of overhead transfer on the "coaling at sea" principle are impracticable when applied to human wounded. A sack of coal may be accidentally submerged without further consequence, but not so a cot with a wounded man in it (Elder).

At the outbreak of the recent war, the British contemplated using the naval hospital ships, analogous to a "*field ambulance station.*"

The employment in this capacity meant that "the ships would cruise about in the immediate vicinity of the fight and be ready

to collect and give assistance to the wounded of damaged and disabled ships as they dropped out of the line, it being understood that friend and foe were to receive equal attention as the occasion arose. The great speed of modern ships of war on the one hand compared with the exceedingly moderate rate of progress of the hospital ships on the other, and again the very obvious difficulties of transferring casualties from one ship to another in any but the calmest weather, soon made it clear that the hospital ship must be condemned to discharge a far less exciting function. They had, therefore, perforce to play a part analogous to that performed in land operations by the *casualty clearing stations;* that is to say, they remained at the base port when the fleet put to sea and received all cases of wounds and disease from the ships when they returned to port, first aid having previously been given by the medical staff of the ships concerned. * * * " (Taylor).

After an action, conditions are immediately changed. There is a sudden influx of cases, many of which may not be serious, but nevertheless all will require some care and attention. Any attempt on the part of the ship to act as a "base hospital" and overcrowd perhaps in the effort to cope with the inrush of cases, can only end in one way—a medical disaster. As for ships limiting their intake of patients to the establishment of beds, that is also out of the question. There are not nearly enough hospital ships in the first place; neither is it necessary that there should be, as hospital ships are a most expensive, though necessary method of providing hospital accommodation for a fleet under war conditions. Finally, the confined space of a ship does not afford an ideal place for the continued treatment of wounded such as are received after a naval engagement.

Hence, in the absence of sufficient base hospitals at the point where wounded are landed, or failing casualty clearing stations where cases can be sorted with reference to removal to one or other of the established naval base hospitals, it devolves upon hospital ships to assume the rôle of "casualty clearing station" pending removal of patients by ambulance train elsewhere.

It is upon the method in which this function is discharged that the success and utility of a hospital ship after a naval action depend. Any hesitation or remissness in "clearing" cases reacts adversely, not only on the ship, but also on the patients. It ends in the ship being unduly congested and consequently "out of action," so to speak, as a "clearing station"; also as a "hospital" she is at once overcrowded and understaffed. Consequently, the best "medical" results are not obtainable under such circumstances (Elder).

The postbattle function of hospital ships will largely be performed by those belonging to the victorious fleet. Because, as has been pointed out by McNabb, there would not be many of the defeated ships left to render assistance to, and secondly, the hospital ships will come under the direction of the victorious commander, who is entitled to give prior use of these to his own wounded.

There is nothing about the practical realities of battle at sea in this age to invite the presence of a hospital ship as offering anything in the way of practical assistance, and her case as regards the needs of the fleet immediately

after action is not much better. She loses nothing of her actual importance because of these facts. She continues to be the backbone of the medical department in the care of the personnel of the fleet (Bell).

The true sphere of the hospital ship, as has already been indicated, was found to be between the anchorages of the Grand Fleet and home ports (Times History of the War).

As soon as the seas are cleared of the last remnant of the enemy's forces the hospital ship can be employed in picking up the men in the water. Perhaps by this time the slower moving hospital transports may have arrived on the scene and the work of picking up the drowning may be left to them, and the hospital ship may turn to render aid to the wounded on the crippled vessels. If they are so damaged as to be rendered helpless, unable to make port without being towed, the wounded should be removed to the hospital ship; but if they can proceed under their own power to the nearest port, military necessity will demand that they lose no time in reaching port. The safety of the vessel itself may be at stake and the ship lost; and, again, any unreasonable delay in getting the ship underway and to port for repairs to enable her to rejoin the line as quickly as possible will be time wasted. Transferring wounded at sea will naturally require considerable time * * *. To meet all conditions most expeditiously medical officers and nurses in sufficient numbers, with dressings, are put on board from the hospital ship and both ships can proceed on their respective missions unhindered (Straeten).

In a battle taking place at high seas, it is an underlying military principle that every effort should be made after battle to evacuate the wounded from the advancing fleet to class A hospital ships, and this reason demands that this class of hospital ship should be a component of an overseas naval expedition, and hence the equipment for transshipment of patients on the high seas must be complete.

Granted that a few dozen of the wounded are lost in the evacuation from combatant ships to hospital ship in high seas, it would appear that there are likely to be conditions where the military value derived from disencumbering the fighting vessels of their battle casualties would justify the subjection of the wounded to this risk. Considering the matter from a humanitarian view, it is probable that the loss of a few wounded during transshipment may result eventually in a greater saving of life by the prompt restoration of the fleet to a fighting condition, necessary for a victorious conclusion in the decisive combat.

From a surgical point of view, it is claimed to be advisable to send naval battle casualties immediately to the hospital facility at which their surgical treatment can be completed, provided they can reach this destination within 24 hours after the wounds were inflicted. After this time septic processes begin; consequently it is important that class A hospital ships or other hospital facilities should be available within 24 hours after action.

At 7.46 of the day after Jutland, the S. O. Fifth Battle Squadron sent a message requesting that arrangements be made for transferring killed and wounded, "observing that cots are not available."

The reply was that, if weather permits, hospital ships will be ordered to go alongside the battleships but in event that the weather is not suitable they will be ordered to anchor near. Later word was sent to the commander in chief suggesting that in view of the severe weather in the Flow the *Berbice* and *Soudan* anchor in Gutter Sound, and that another hospital vessel with 45 cots and blankets be sent to the *Iron Duke* for orders.

On June 2 the British commander in chief of the Grand Fleet sent this message to the *Cyclops:* "Immediate orders for hospital ships will be sent on arrival * * *. Please arrange to have bodies removed from ships as soon as possible."

Evacuation

"To the uninitiated, the paramount necessity for a well-thought-out routine for embarkation and disembarkation is perhaps not obtrusively evident. It must, however, be realized that an outstanding characteristic of the hospital ship, as compared with other hospitals, is the constant liability to the admission or discharge of patients in mass, together with special difficulties in transportation. Consequently, an arrangement is necessary which will permit these operations to be carried out rapidly, quietly, and without confusion, and its exceptional importance in war time, when requirements are increased and speed may be vital, need not be emphasized * * *" (Sutton).

Hemsted has worked out a very ingenious scheme of segregating patients on embarkation according to diseases, nationalities, and ports of debarkation, and also to furnish each patient a ticket assigning him to a lifeboat. It is well worth while to study this system.

Hospital ship evacuation is *direct* where the patients are removed from ship to ship or from ship to dock without intermediate conveyances, while *indirect* evacuation refers to use of small boats as an intermediate means. The topic will be discussed under the following captions:

1. Evacuation to hospital ships.
2. Evacuation from hospital ships.

Evacuation to hospital ships.—As a general rule, evacuation from combatant vessels to hospital ships is accomplished by the medium of small ambulance boats, although the British were able to evacuate the battle casualties from light vessels by *direct transshipment*—the light cruisers and destroyers coming alongside the hospital ship in the harbor.

Transshipment of the wounded has been recognized for years as a difficult task, as will be illustrated by the following historical instance:

Seeing that the condition of the *Richard* was hopeless, Jones decided to transfer his crew to the *Serapis*, and it appears that slings were used to effect transshipment of the wounded.

"Accordingly, all available hands were put at the pumps, and the work of transferring the wounded was begun. Slings were rigged over the side; and the poor shattered bodies were gently lowered into the boats awaiting them, and, on reaching the *Serapis*, were placed tenderly in cots ranged along the main deck. All night the work went on; and by 10 o'clock the next morning there were left on the *Richard* only a few sailors, who alternately worked at the pumps, and fought the steadily encroaching flames" (Abbott) (31).

The plan adopted by the British in the World War was to transfer the wounded to high-speed destroyers after a minor engagement and to send them to the nearest base, the hospital ship having been notified to meet the destroyers. The two destroyers carrying back the wounded from the sinking of the *Pathfinder* were able to meet the hospital ship in the mouth of the Forth, transfer the wounded, and return to their patrolling station in the North Sea. Fog or other adverse meteorological conditions may interfere with the transference of the wounded. Thus, after the Helgoland fight the destroyers were unable to enter the harbor for this reason, and steam barges were used to convey the wounded to hospital ships.

"One of the prime requisites of a hospital ship is ability to transfer speedily patients from another ship or to a base hospital. To secure this end nests of power boats should be provided, with cranes to launch them quickly" (Raison).

Hospital ships should fairly "bristle" with small boats for transshipping patients, since it is reasonable to suppose that such vessels must supply these small boats, as those of the fighting ships perhaps will have been damaged or destroyed in action.

For example, after Jutland, the *Lion* reported no small boats available. The admiral of the Grand Fleet sent a wireless for all hospital drifters to muster on arrival. For the conveyance of patients from and to hospital ships in the harbor, the British utilized converted drifters, or ship's picket boats and cutters. Some of the drifters were fitted to carry 18 stretcher cases under cover, and these boats in bad weather proved "far preferable to ship's boats" (Elder).

Subchasers were found by Old to serve very satisfactorily as ambulance boats. These boats were able to come alongside the hospital ships and the patients were passed by hand through one of the large cargo ports. In only one case was any damage done to the subchaser coming alongside, and this accident was caused by the chaser's yard fouling the rail of the hurricane deck, which

leads the writer to suggest that similar accidents could be prevented by constructing the masts of ambulance boats with yard made into a cockbill, or lowered.

For expeditious transfer of the wounded, hospital ships should be provided with "wide gangways, booms, cranes, slings, trolley devices, and side ports" (Stokes).

Large cargo ports for the transfer of the wounded from ships or boats alongside were first used by the Japanese, yet conditions may exist which prevent the use of this method, and raising and lowering patient by means of derricks, cranes, and other devices must be resorted to.

On transferring over 400 patients from the *Northern Pacific* to the *Solace*, under conditions where the swell of the sea prevented use of the gangway for removal of stretcher patients from small boats, they were hoisted aboard by means of the sliding crane, with traveler, to which a hoisting block is attached, as is installed on either quarter of the *Solace*. Over two hundred men were hoisted from motor sailers, often at the rate of one a minute, without the slightest accident. The sling used for this purpose had a ring with four lines; at the end of each line were snap hooks. The two headlines were shorter than the footlines.

Two other lines with snap hooks were used as guys from the small boat to control the head and foot of the Stokes stretcher while being hoisted. The use of snap hooks on guy lines and sling lines expedited transfers as no time was lost in tying knots, and getting lines of proper lengths. Slings and guys of this kind are recommended by Old as a part of the equipment of the medical department for use in transfer at sea.

A similar, and perhaps identical, hoisting apparatus has been described by Blackwood, which consists of an arm extending 8 feet, over the ship's side, with a traveling four-wheeled trolley with block and tackle. At outer end of the beam is a pulley over which is run a guy line attached to the trolley. By means of this line the trolley is run out to the end of the beam and secured. At the lower end of the block is a hook to which the stretcher is secured by means of an eight-tailed bridle.

The sanitary report of the U. S. S. *Relief*, for the year ending December 31, 1921, says that the special apparatus (presumably the above-discussed appliance) constructed on the starboard and port quarters for the handling of a stretcher case in a seaway was dismantled and removed when it was found unsatisfactory. It raised the stretchers so slowly that it was impossible to get them aboard without danger of swamping.

On several occasions patients were transferred to the *Relief*, while at sea, by means of a simple rope and sister hooks used to haul the

stretchers up by hand. This method was reported to be very satisfactory.

Hewitt used skids for transferring patients on board the hospital ship *Gascon*. The loaded stretcher was on a skid and, accompanied by a man at each end, was hoisted on board by means of a derrick.

The British made use of a wooden tray, termed "cot carrier," for hoisting a patient placed in the standard navy cot. The tray, suspended by four wire slings, was fitted in the bottom with three transverse rollers for sliding the cot in and out. Two removable tailboards are fitted in each end of appliance. Cushion trestles receive the tray both inboard and outboard. Large platforms have been used as a conveyance for hoisting several stretcher patients at the same time. (Fig. 7.)

Modern trays have been reported as a source of danger in rough weather to patients and attendants, and Robson found that canvas slings did the work in one-quarter of the time. By using only one crane, 16 cases were removed by this method from the *Salta* in nine and a half minutes under conditions of rather rough weather with a northeast gale blowing (32).

Stephens and Zur Verth both call attention to the fact that the transshipment of wounded is a matter of seamanship, which should be largely left to the line to deal with.

Following the naval engagement near Skagerrak, the German hospital ship *Sierra Ventana* transshipped 41 wounded and 16 dead from the auxiliary hospital ship in a period of one hour by use of the double-litter carrier, the time being reckoned from the moment of coming alongside until shoving off.

If possible, the evacuation should take place under protection of the waters near shore, because a ship slowing down or standing dead in the water increases the risk from submarines. The ideal method of transferring patients at sea would be by the use of an aerial cable connecting the delivering ship and the receiving ship, as the patients could be transferred while both ships are under way, thus diminishing the menace from submarines which are liable to be present after battle while the wounded are being transferred. The Stokes device appears to be the original apparatus utilizing the principle of aerial cables; although the idea may be correct in principle, it has not been developed mechanically to a practical stage, yet it is worthy of further consideration with a view to its improvement.

Stokes's apparatus consists, roughly, of a steel hawser made fast to the combatant ship and a weight over the side of the hospital vessel, sufficiently in excess of the weight of the hawser and patient to keep the hawser taut and clear of the water. It is said this type of apparatus can be used in any seaway in which guns can be fired with any degree of accuracy.

Evacuation from hospital ships.—Disembarkation is the converse of embarkation and implies not only the landing or removal of patients, but also of their baggage and the necessary service documents. "The important points in a good disembarkation scheme are: (1) *Rapidity;* (2) *decentralization*, by which is meant that the different branches of the work are subdivided into separate and distinct units, although each unit is supervised by, and hands the final results of its work to, the senior medical officer; (3) *absence of fuss.* If the first two are efficiently attained, the third automatically follows" (Sutton).

The hospital ship should radio in advance the number of patients for transference in order that motor ambulances, ambulance boats, hospital trains, and other necessary conveyances can be assembled in time to assist in the disembarkation. Care must obviously be taken that no weak links exists in the chain of evacuation, and, with this in view, the British Navy organized a separate department—designated the "Naval Medical Transport Department"—that functioned in maintaining the evacuation lines from the hospital transport to the receiving hospital ashore.

The Japanese hospital ships used three flatboats alongside for debarking the wounded. In one boat were placed the stretcher cases, one was reserved for ambulant wounded, and the third conveyed the patients' effects ashore.

To convey some idea of the arrangements required to disembark the wounded during the World War, it may be mentioned that during some weeks the British hospital ships landed over 6,000 patients—a majority of which were stretcher cases. One ship alone carried over 180 thigh fracture cases. The unloading took place night and day, and often two or more hospital ships were debarking at the same time. About 100 litter bearers were assigned each vessel to assist in unloading the wounded. Wheeled litter carriers, constructed of a light tubular frame placed on four bicycle wheels, were found to be a labor saving device.

Withers (33) has described a method of direct disembarking of the wounded, which reduces the jolting and shaking to a minimum. This method consists essentially of removing the stretcher patient by means of a traveling trolley fitted to an overhead wire rope, running from the ship's deck down the gangway to the dock. The wire ropes are supported on trestles fitted with rocking saddles.

In the first trip to Palermo the Italian hospital vessel *Regina d'Italia* landed 330 patients in only two hours, and on another occasion 399 patients were disembarked in two and a half hours.

Credit is acknowledged to Lieut. Commander R. G. Davis, Medical Corps, United States Navy, for the preparation of the following

remarks on the possibilities of aerial transportation of the sick and wounded:

With the rapid development of aviation the airplane must be considered as a positive factor in the evacuation of casualties after a naval engagement. The practicability of aerial ambulance is well established in peace-time activities employing both the land and sea type of planes. First aid is promptly received and suffering greatly shortened by comfortable and rapid transport to a hospital. In time of war the amphibian type of ambulance, attached to a carrier, would meet sea conditions due to its ability to take off from the carrier deck and land alongside of ships, removing casualties, and returning to the carrier or landing ashore if conditions permit. The large bombing seaplanes are capable of carrying two stretcher cases and could be pressed into service after their mission was completed. Plane casualties may be promptly rescued from moderate seas and removed to near-by hospital ships, adding much to the established resourceful plans of medical evacuation.

The possibilities of naval aviation tempt one to conjecture. Satisfactory and expeditious transportation by airplane ambulances of the wounded of land forces is already an accomplished fact, as has been proved by the French Army operating in Morocco; and the use of naval airplanes to relieve the fighting ships of their battle casualties by evacuation to hospital ships, airplane carriers, or to near-by shore hospitals does not appear to be impracticable.

The planes of a carrier may be utilized as a rapid means for the evacuation of the wounded after battle from combatant ships, since speed is one of their foremost characteristics, and it is quite possible that their sick bays may be able to serve as links in our chain of evacuation. In fact, they suggest that the ideal hospital ship of the future may be constructed after the same general type, carrying a number of aerial ambulances and functioning somewhat similar to the ambulance company of the medical regiment—again drawing attention to the parallel existing between the medical formations of the land and sea forces.

The use of plane ambulances to transport battle casualties to hospitals in the rear may result in the elimination of one or more of the intermediate hospital facilities in the echelon of aid to the wounded. (Stitt, Military Surgeon, 57:341.)

Beyer has developed a formula for evacuation of patients, based upon certain formulas worked out by Macpherson for land forces:

Taking T to represent the time allowed, W the number of sick and wounded, t the time required for boats to make one trip to the hospital ship and return, M the number of boats available, and n the number of patients each boat can carry, we get the following formula:

$M=\frac{W\times t}{T\times n}$ for the *number of boats* required for the transfer of a given number of wounded to the nearest hospital ship, or

$T=\frac{W\times t}{M\times n}$ for the time required with a given number of boats to evacuate a given number of wounded to a hospital ship.

For example, our 1,858 wounded are to be transferred to hospital ships in four hours; how many boats would be required to effect their transfer?

Supposing that our boats can make one round trip in two hours and could accommodate either eight lying-down patients or 30 sitting-up ones. We assume the boats to be the ordinary sailing launches in tow of steam launches.

Two-fifths, or 743, of our 1,858 wounded require lying down transport and three-fifths, or 1,115, of them can sit up.

For the lying-down cases we would require: $M=\frac{743\times2}{4\times8}=46.50$ boats.

For sitting up cases we would require: $M=\frac{1115\times\ 2}{4\times30}=18.63$ boats.

Total number of boats required=66.

Since, moreover, small boats as well as steam launches belonging to battleships may be scarce after a battle, it would point to the necessity of fitting out hospital ships with an unusually large number of such boats as well as with transport material, as stretchers, etc., only a limited amount of which can be stored on battleships. (Beyer, H. G.: The Military Surgeon, January, 1910.)

Attempted or Alleged Misuses of Hospital Ships

The preparation of international rules relative to the employment of hospital ships in war was designed primarily for the amelioriation of the condition of the wounded, yet it would appear that certain portions of these rules have basic military value—particularly the article restricting the use of hospital ships exclusively to medical purposes—which may be demonstrated by the following instance. At the time of the American Civil War, before the days of the Geneva Convention, there were no international agreements limiting the operation of hospital ships to strictly medical uses, yet it appears that special military situations arose requiring regulations of this sort. A general order dated February 6, 1865, states:

> Hospital transports and hospital boats, after being properly assigned as such, will be exclusively under control of the Medical Department, and will not be diverted from their special purpose by orders of the local department commanders, or of officers of other staff departments.

It would appear fitting, for chronological as well as for other reasons, to consider first our own apparent misuses of hospital ships during war, thus giving prominence to these alleged shortcomings in this respect.

In a note of April 23, 1898, the Swiss minister at Washington proposed the formal adoption by the Governments of both belligerents of the Additional Articles of the Geneva Convention as a *modus vivendi* during the existing war. The proposal was agreed to by the United States and Spain.

Since the Government of the United States was one of the first to adopt the proposed articles of the Hague Convention and applied them during the Spanish-American War, it would be natural to expect this Nation to adhere rigidly to these terms. This was not always the case, however, as shown by United States Senate Document No. 205, and House of Representatives Document No. 552, of the Sixtieth Congress, first session, which are the authority for the three incidents listed below.

(*a*) The commander of the hospital ship *Solace* flying the Red Cross flag and professing neutrality, put in a claim for prize money for the part which this ship took in the capture of the *Adula.*

(*b*) The *Solace* is said to have interfered with the progress of a schooner in the Old Bahama Channel so that the United States naval torpedo boats could board and investigate this craft.

(*c*) The *Solace* sailed from New York for Cuba with armed men on board, but was recalled after passing through the Narrows and the armed men were removed.

It would appear that a defense of our actions in failing to observe the conventional rules may be based upon the fact that the Spanish-American War was the first conflict fought under the stipulations of the new convention, and adequate time had not elapsed since their adoption to enable the American naval service to be thoroughly indoctrinated into the newer requirements. Formulate, however, any other explanation as may seem most logical, the facts of the case furnish evidence of rather radical breaches of the fundamentals governing the use of hospital ships in war.

Apparent violation of the international convention occurred again during the next war—the Japanese-Russian War, as is shown by the case of the hospital ship *Orel*, whose actions were also governed by this earlier Hague Convention (1899).

The *Orel* was of 7,663 registered tonnage, belonging to the famous Russian Volunteer Fleet. In the beginning of this war she was chartered by the Russian Red Cross for use as a hospital ship and, after the consent of the Japanese Government had been obtained, she was equipped and joined the Baltic Fleet on its voyage to the Far East.

In the Battle of the Sea of Japan, May 27, 1905, she was visited by a Japanese cruiser, taken to Miura Bay, and detained as a prize, for the alleged reasons that she had rendered warlike assistance to the Russians which was incompatible with her privileged character.

She had on board as prisoners bound for Vladivostok, the master and three others of the British steamship *Oldhima*, which vessel had been sunk by the Russian cruiser *Oleg.* These persons were neither sick, injured, nor disabled, but able-bodied, and should have been detained on the cruiser.

When she was brought up for adjudication at Sasebo her log books, statements in which were further verified by the deposition of the master and other officers, showed that she had acted on one occasion as a dispatch boat for the commander in chief; on another she had been detached in order to purchase munitions of war at Cape Town; and finally she had acted as a scout while the fleet was approaching Tsushima Straits. The Japanese prize court at Sasebo held that she had forfeited her immunity and condemned her as a prize.

In the World War the Italian cruiser *Puglia* while operating in the Red Sea captured the Turkish hospital ship *Kaiserich* on the ground that defectiveness of equipment denied her the right of the privileged position conferred by the Hague Convention relating to the rules of maritime warfare (34). This vessel, flying the Red Crescent insignia instead of the Red Cross, appeared to have no sick-bay accommodations, no medicines, no surgical appliances or supplies, except 8 kilograms of cotton. Furthermore, there were no medical attendants on board.

In the World War the society of the Red Crescent outfitted the *Gul-Nihal* as a hospital vessel. The Russian Government refused to grant it free passage through the Black Sea, giving as a reason that the Turks failed to ratify the convention of 1907. The Turkish Government replied that Russia had respected the Red Crescent insignia in 1877, and the Turkish Government would agree to the latter convention of Geneva, provided they be permitted to replace the Red Cross flag by the Red Crescent, to which the Russian Government assented.

The case of the German hospital ship *Ophelia* appears the most striking example in the World War of the attempted or alleged misuse of such vessels.

The *Ophelia* was sighted first on October 8 by a British submarine. The circumstances of her suspicious movements, as related by the commanding officer of the submarine, are given below:

> At 10 a. m., when the steamer was about 4½ to 5 miles from me and was in a position which could be accurately described as near Schiermonikoog, she evidently sighted me. She hoisted a large Red Cross flag at the main. At the same time dense black smoke commenced pouring out of the funnel and she began to increase speed and bear away to the northward. I increased speed to 11 knots.
>
> At 10.5 a. m. the steamer altered course to east still increasing speed and she hauled down the Red Cross flag. There was no apparent reason for her to do so, unless the taking down of the flag was a signal to the enemy or it was a flag she was not entitled to fly. I also altered course east, thereby placing the steamer fine on my port bow.
>
> * * * The steamer quite unmistakably fled from me after sighting me in order to escape search.

The hospital vessel was brought finally into Yarmouth on October 18, 1914, by the *Meteor* on the grounds that she was not entitled to immunity from capture on account of her suspicious movements, and the character of her equipment, which suggested that she might be intended for use as a signal ship.

Before the boarding officer could inspect the vessel the medical officer in command, Doctor Pfeiffer, destroyed the official and important documents, and, concerning this "spoliation of documents," the judgment states that the records of hospital ships must be clean,

and there ought to be no question about the innocence of hospital ships from engaging in warlike purposes. If the records are "not preserved, but destroyed, the inference that, if produced, they would be silent but eloquent witnesses of guilty practice would be strong." The court, however, did not complain of the destruction of secret documents, such as the secret wireless code, but referred their remarks to official papers which would throw some light on the operation and stores of the ship.

According to the London Times of April 26, 1915, the Secretary of the British Admiralty stated that "her name had not been notified to his Majesty's Government as a hospital ship in accordance with the requirements of the Convention."

The London Morning Post of May 9, 1915, makes the statement to the effect that the German Government on September 11 issued a certificate declaring her to be a hospital ship. Thus it would appear from the above two statements that the status of the *Ophelia* was a "hospital ship" from a *national* but not from an *international* viewpoint.

This ship was found to carry apparatus and appliances suitable for signals—the number of Very's lights totaling over a thousand, several times the allowance of battleships. The defense admitted that she had never had on board a single shipwrecked or wounded person.

The evidence compelled the conclusion that she was not constructed, adapted, or used as a ship for the special and sole purpose of affording aid and relief to the wounded, sick, and shipwrecked; and that she was adapted and utilized for military purposes as a signaling ship, thereby forfeiting protection claimed under the Hague Convention.

The naval prize court, on May 21, 1915, condemned the vessel as a lawful prize.

The following data concerning the alleged misuse of British hospital ships are abstracted from Miscellaneous No. 16 (1917)—Cd. 8692, published by His Majesty's Stationery Office, London.

In a memorandum, dated January 28, 1917, the German Government made allegation of misuse of British and allied hospital ships, and in 23 annexes fiurnished evidence tending to prove or point to such misuse. A further memorandum of March 29, 1917, repeated these allegations in general terms.

The charges were classifiable under four headings, viz:

1. Alleged excessive number of hospital ships in relation to the Gallipoli campaign.
2. Changes in the list of hospital ships, with supposed intention to deceive.
3. Alleged transport of munitions.
4. Alleged transport of troops.

The first memorandum of the German Government concludes with the following:

In view of the breach of treaty committed by their enemies the German Government would be entitled to free themselves altogether from the obligations contained in the Convention; for reasons of humanity, however, they desire still to refrain from doing so. On the other hand, they can no longer permit the British Government to dispatch their troops and munition transports to the principal theater of war under the hyprocritical cloak of the Red Cross. They therefore declare that from this moment on they will no longer suffer any enemy hospital ship in the maritime zone which is situated between the lines Flamborough Head to Terschelling on the one hand and Ushant to Lands End on the other. Should enemy hospital ships be encountered in this maritime zone, after an appropriate lapse of time, they will be considered as belligerent and will be attacked without further consideration. The German Government believe themselves all the more justified in adopting these measures as the route from western and southern France to the west of England still remains open for enemy hospital ships, and the transport of English wounded to their homes can consequently be effected now as heretofore without hindrance.

In justice to the action of the German Government in forwarding the note, attention is invited to the fact that the above paragraph does not place a prohibition on the use of British hospital ships, but tends more to what might be called an attempt to restrict and limit their activities. The only authority on which the German Government could possibly base such action to exert limited control over the enemy's hospital ships appears to be a very broad interpretation of article 4, HCX, which is quoted: "The belligerents shall have the right * * * to make them take a certain course."

The British Government in a reply categorically denied these accusations and furnished evidence in refutation. This reply called attention to "the remarkable fact that German submarines and other warships have never once exercised the right of inspecting British hospital ships, which is given to them by article 4 of the Hague Convention, for the application of the principles of the Geneva Convention to maritime warfare. So far as can be ascertained they have only once stopped a British hospital ship long enough to examine her papers. This occurred on February 23, 1917, when the hospital ship *Dunluce Castle* was stopped by a German submarine in the eastern Mediterranean; her papers were found to be in order and the vessel was allowed to proceed."

The contentions put forth by the German Government do not appear to be substantiated by valid evidence, and perhaps an ulterior motive is discernible. Hyde (21) says: "German submarine attacks on allied hospital ships in the course of the World War were notorious. The allegation by the German Government in its memorandum of January 28, 1917, of misuse of British hospital ships was in

all probability put forth as an excuse for the deliberate attacks upon such vessels incidental to a naval policy which sought to divert enemy destroyers from the work of safeguarding the transportation of military forces and supplies to that of convoying hospital ships. The ruthlessness of the plan caused the British Government to remove from such vessels their distinctive markings and to conceal rather than proclaim their beneficent missions."

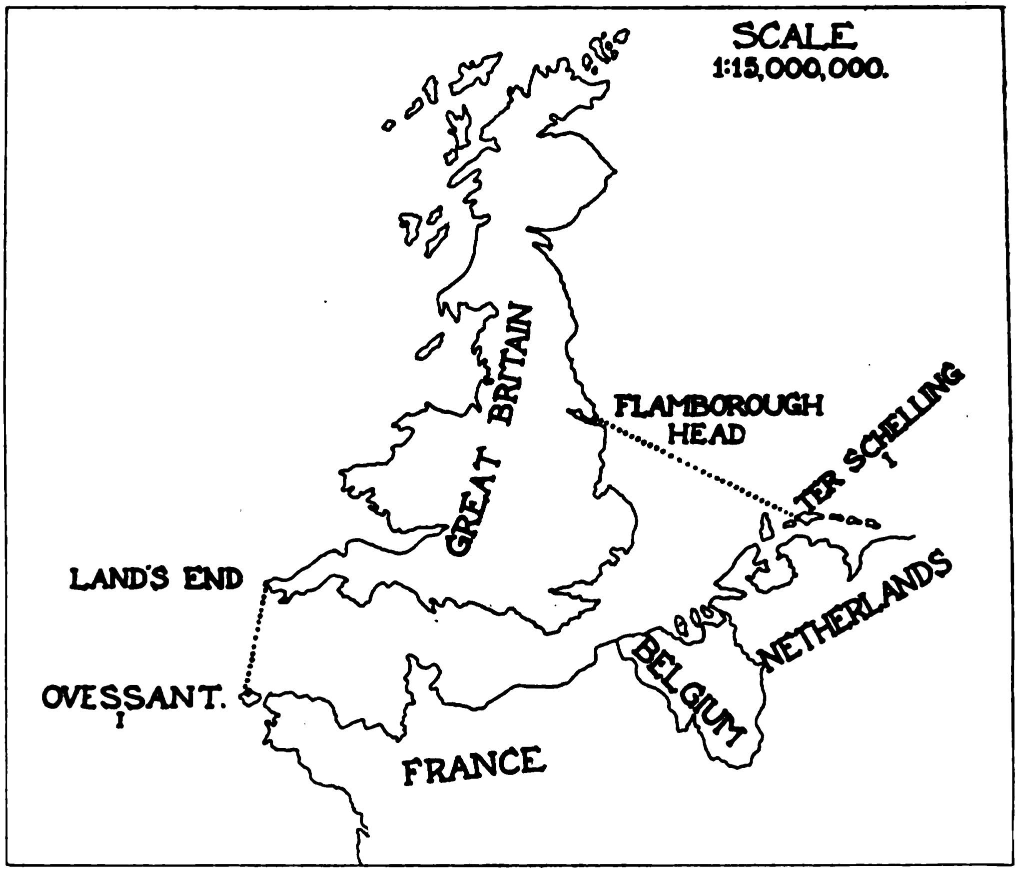

FIG. 12.—Zone barred to hospital ships by the note of the German Government, dated January 28, 1917. (After Barbier)

A Reuter's telegram from Geneva, dated April 22, stated that the International Red Cross Committee had addressed a note to the German Government referring to the German order issued on January 29, 1917, regarding the sinking of hospital ships and the torpedoing of the hospital ships *Asturias*, *Britannic*, and *Gloucester Castle*.

The protest is in the following terms:

The International Committee, whose right and duty it is to enforce respect for the principles of the Red Cross and the Geneva Convention by reporting violations of them, draws the very serious attention of the German Govern-

ment to the responsibility which it would assume toward the civilized world by persisting in a resolution which is in contradiction to the humanitarian conventions which it has pledged itself solemnly to respect.

In torpedoing hospital ships it is not attacking combatants but defenseless beings wounded or mutilated in war and women who are devoting themselves to the work of relief and charity. Every hospital ship is provided with the external signs prescribed by international conventions, the use of which has been regularly notified to belligerents. The latter may, according to the Hague Convention, exercise the right of search, but have in no case any right to sink a ship and expose to death the hospital staff and the wounded.

The *Asturias* appears to have been torpedoed without any care having been taken to ascertain her character or her destination. Even if the correctness of the facts were admitted upon which Germany bases justification of her order, the International Committee considers that nothing can excuse the torpedoing of a hospital ship, and expresses the hope that such an order, contrary to international conventions, will cease to be carried out.

From the refusal of the German Government to tolerate the hospital ships within certain limits only one conclusion could be drawn—"namely, that it is the intention of the German Government to add yet other and more unspeakable crimes to the long list that disgraces their record."

The Government of the United States was requested to inform the German Government that if the threat were carried out immediate reprisals would follow.

The course dictated by humanity and common sense was plain, and needed no reminder such as was given by the British Government. Yet in spite of their emphatic denials of the German falsehoods and the subsequent warning conveyed, the British hospital ship *Asturias* was torpedoed without warning on the night of March 20. The ship was steaming with all navigation lights burning and the proper Red Cross sign brilliantly illuminated. The cumulative evidence that she had been torpedoed and not mined was only accepted after it has been confirmed beyond all doubt and after exhaustive investigation. The loss of life on this occasion included a nursing sister and a stewardess, a fact which might have brought home to any enemy but Germany some sense of the enormity of the outrage.

But the nation responsible for the murder of Nurse Cavell appears to have accepted the intelligence with composure, if not with satisfaction. The German official wireless message of the 26th finally established the guilt of the German Government, who, having boasted of the deed, published on the 29th a further message which said: "It would moreover be remarkable that the English in the case of the *Asturias* should have abstained from their customary procedure of using hospital ships for the transport of troops and munitions."

On the night of March 30–31 the hospital ship *Gloucester Castle* met with a similar fate. On this occasion the Berlin official wireless message again cynically published a notification that she was torpedoed by a U-boat, thus removing any possible doubt in the matter.

The British Government thereupon authorized prompt measures of reprisal in accordance with the announcement already referred to, and on April 14 a large squadron of British and French airplanes bombarded the German town of Freiburg with satisfactory results. (From an announcement of British Admiralty of April 22, 1917.)

Attacks on Hospital Ships

There was no discoverable instances of willful attacks on hospital ships prior to the World War, although the Russian hospital ship *Kanzan*, in the bombardment of March 26, 1904, was struck by a 12-inch shell which did not explode. According to Holcomb, the *Angara* was sunk during the bombardment of Port Arthur, but this was not in violation of her neutrality as her position in the line of fire did not entitle her to immunity.

In reading the charges and countercharges of the belligerents in the World War, relative to the violation of the Geneva and Hague Convention, one—if not most conservative in forming opinions—will likely get the impression that the conventional rules were rarely observed and that there was a wholesale attempt to sink hospital ships, destroy military hospitals, and kill the sick and wounded.

In considering the allegations of striking violations by the nations taking part in this conflict, due allowance must be made for the magnitude of the recent war, which was fought on such a grand scale that individual instances of criminal intent, errors of judgment, accidents, and mistakes are liable to occur.

The exaggerations, propaganda, and lack of accurate and reliable information—inevitable under stress of war conditions—serve to give an erroneous idea of the character of the observance paid by the combatants to the international rules of war.

The causes of violation of these rules may be summarized as:

1. Deliberate criminal intent of individual officials of the belligerents.
2. Failure to detect the status of a hospital ship or other medical formations.
3. Unavoidable accidents.
4. Retaliations and reprisals for actual or apparent failure of their opponents to observe conventional obligations.
5. Failure to interpret properly the conventional rules.

One medical officer expresses his opinion of the observance of conventional rules by his opponents thus—the Turks "certainly respect hospitals and hospital ships, and they never put any impediment in the way of the rapid evacuation of the wounded from the shore" (Chitty). "Hospital ships are allowed to anchor quite close to land and embark their cases unmolested."

"Even hospital ships * * * have been sunk with the same reckless lack of compassion or principle" (President Wilson's address to Congress, April 2, 1917).

"It must be clear that it is a constant temptation to a belligerent to employ a hospital ship for minor military uses, such as the trans-

portation of individuals or supplies, or the communication of intelligence, and so to rob such a vessel of its normal immunities. If, however, a hospital ship remains unarmed, the right of the enemy, to prevent the abuse of its privileges, as by capture and detention, ought not to embrace the right also to attack the ship as if it were a battle cruiser. The Hague Convention does not sanction such procedure" (Hyde).

The hospital ship *Rewa* was torpedoed and sunk in the English Channel about midnight January 4, 1918, while on her way home from Gibraltar. She was displaying all the lights and markings required by the Hague Convention, and was not, and had not been, within the so-called "barred zone," as delimited in the note issued by the German Government January 29, 1917. She was the sixth British hospital ship known definitely to have been torpedoed without warning during the previous 10 months, each attack occurring during the night (J. A. M. A. 70:475).

The Russian hospital ship *Narodovolets* was sunk in the Neva. Plans are being made to raise it.

Allied hospital ships sunk during the World War (not complete)

Name	Nationality	Date	Locality	Cause
Anglia	Great Britain	Nov. 17, 1915	English Channel	Mine.
Galeka	do	Oct. 28, 1916	do	Do.
Britannic	do	Nov. 21, 1916	Aegean Sea	Do.
Braemar Castle	do	Nov. 22, 1916	Mykoni (Mediterranean) Channel.	Do.
Asturias	do	Mar. 21, 1917	Barred zone	Submarine.
Gloucester Castle	do	Mar. 31, 1917	Barred zone (English Channel).	Do.
Salta	do	Apr. 10, 1917	English Channel	Mine.
Donegal	do	Apr. 17, 1917	Barred zone	Submarine.
Lafranc	do	do	do	Do.
Dover Castle	do	May 26, 1917	Barred zone (Mediterranean)	Do.
Rewa	do	Jan. 4, 1918	English Channel	Do.
Glenart Castle	do	Feb. 26, 1918	Bristol Channel	Do.
Marechiaro	Italy	February, 1916.	Albanian coast	Mine.
Llandovery Castle	Great Britain	June 28, 1918	Off Ireland	Submarine.
The Portugal	Russia	Mar. 30, 1916	Black Sea	Do.
Vperyod	do	July 10, 1916	do	Do.

Following are listed the number lost in some of the sinkings (after United States Naval Institute, 43–2303):

	Lives lost		Lives lost
Portugal	115	*Llandovery Castle*	235
Vperyod	7	*Dover Castle*	2
Brittanic	50	*Salta*	52
Asturias	44	*Glenart Castle*	164
Donegal	41	*Anglia*	100
Lafranc	34		

So much publicity has been given the sinking of hospital ships that it would appear wise to present some of the measures, under-

taken after the termination of the war, to bring those responsible to justice. This establishes a naval precedent. It should be of interest to medical officers to know that at least some of the parties guilty of attacking hospital ships have been convicted and punished. In article 228 of the treaty of peace with Germany, provisions were made to effect this. This article is quoted below:

> The German Government recognizes the right of the allied and associated powers to bring before military tribunals persons accused of having committed acts in violation of the laws and customs of war. Such persons shall, if found guilty, be sentenced to punishments laid down by law. This provision will apply notwithstanding any proceedings or prosecution before a tribunal in Germany or in the territory of her allies.
>
> The German Government shall hand over to the allied and associated powers, or to such one of them as shall so request, all persons accused of having committed an act in violation of the laws and customs of war, who are specified either by name or by the rank, office or employment which they held under the German authorities.

In accordance with Article 228, the following two names, with short particulars of alleged outrages, were among others submitted to the German Government for trial by the Supreme Court at Leipsig (35).

> (1) Commander Helmut Patzig, who was charged with having sunk, without warning, the British hospital ship *Llandovery Castle* and with having subsequently fired on and sunk the boats containing the survivors with the consequent loss of 234 lives.
>
> (2) Lieut. Commander Karl Neumann, who was charged with having torpedoed, without warning, the British hospital ship *Dover Castle*, when homeward bound from the Eastern Mediterranean fully laden with sick and wounded, with the loss of six lives.

As the whereabouts of Commander Patzig were unknown, he was not brought to trial; however, his property was sequestrated. The German Government in June, 1921, intimated, as a result of inquiries into this case, that Lieutenants Dithmar, an officer in the German Navy, and Boldt, a retired officer in the German Navy, appeared to be implicated and partially responsible for the outrage with which Patzig was charged.

Lieutenants Dithmar and Boldt both refused to make any statement, for the reason that they had pledged their word to Commander Patzig, the commanding officer of the submarine *U-86*, that they would give no information as to the events which happened in connection with the sinking of the hospital ship *Llandovery Castle*.

After hearing witnesses, and the witnesses called by the German authorities themselves, who included a number of the members of the crew of the submarine, the court found that the *Llandovery Castle* was a British hospital ship, that she was properly equipped

and lighted, and was used solely for the purposes of a hospital ship and carried no combatants or munitions of war; that she was on her proper course; that she was followed by the submarine *U-86* for several hours and when her lights were lit she was recognized as a hospital ship beyond any possibility of doubt; and that after fully considering the matter and discussing it with the members of his staff, Commander Helmut Patzig torpedoed the vessel without warning. The court further held that at least three boats got safely away from the ship with survivors in them, and that the boats were found and searched by the submarine, whose commander professed to hold the belief and was attempting to prove that the vessel carried eight American flight officers; failing to find in the boats any justification for torpedoing the ship, Commander Patzig with the approval and concurrence of Lieutenants Dithmar and Boldt (who with the Gunner Meissner—now dead—were alone on the deck of the submarine with the commander at the time), deliberately fired on the surviving boats and hit and destroyed two out of the three of them with the consequent loss of life of all the persons who were in them. Commander Patzig required and obtained from the officers, crew, and prisoners in the submarine a pledge to maintain silence as to the incident until the conclusion of the war, and he further concealed all traces of his act by omitting any reference to the incident from the log book and forwarding a falsified chart of the courses of the submarine to the German Admiralty.

The court recognized that Commander Patzig, the commander of the submarine, was primarily responsible for this outrage, but held that the plea of superior orders would not avail Lieutenants Dithmar and Boldt in such a case. While relieving them of responsibility for the torpedoing of the ship, the court found that they had taken part and concurred in the firing on the boats and that they could have prevented this action by refusing to pledge themselves to secrecy and declaring their intention of reporting the incident upon their return to port.

The results of the trial are listed below.

Name	Result	Sentence
Lieutenant Dithmar	Convicted	Four years' imprisonment and dismissal from service in the German Navy.
Lieutenant Boldt	do	Four years' imprisonment and deprivation of right to wear uniform as a retired officer.

Regarding the sinking of the *Llandovery Castle*, Doctor Schmidt, president of the German Supreme Court said, "At least three life boats got clear * * *, the court finds these boats were fired

on intentionally with the object of removing witnesses who could testify to the misdeed of the submarine commander * * *.

"This terrible case casts a shadow over the German Navy and the whole submarine war" (Associated Press dispatch, July 16, 1924).

Lt. Commander Karl Neumann in command of the Submarine U–67 which sank the hospital ship *Dover Castle* in the Mediterranean on May 26, 1917, was acquitted because he acted in obedience to the following service order which he rightly considered as binding.

The order of the German Admiralty issued on March 29, 1917, to the flotilla in the Mediterranean reads as follows:

As from April 8 hospital ships generally are no longer to be permitted in the blockaded area of the Mediterranean, including the route to Greece. Only a few special hospital ships, which have been notified by name, at least six weeks previously, may use the channel up to the port of Kalamata. Advise submarines that as from April 8 every hospital ship on the routes named is to be attacked forthwith, excepting such only as have been expressly notified from here, in which cases speed, times of arrival and departure will be exactly stated.

In the judgment in this case the court remarks:

It is a military principle that the subordinate is bound to obey the orders of his superiors. This duty of obedience is of considerable importance from the point of view of the criminal law. Its consequence is that, when the execution of a service order involves an offense against the criminal law, the superior giving the order is alone responsible.

The Admiralty staff was the highest service authority over the accused. He was in duty bound to obey their orders in service matters. So far as he did that, he was free from criminal responsibility. Therefore he can not be held responsible for sinking the hospital ship *Dover Castle* according to orders.

Under paragraph 47 of the Military Penal Code quoted above, there are two exceptional cases in which the question of the punishment of a subordinate who has acted in conformity with his orders can arise. He can in the first place be held responsible, if he has gone beyond the orders given him. In the present case the accused has not gone beyond his orders. It was impossible to give a warning to the *Dover Castle* before the torpedo was fired, because she was escorted by two warships. The accused is not charged with any peculiar brutality in sinking the ship. On the contrary he made it possible to save all the sick and wounded on board the *Dover Castle* by allowing about 1½ hours to elapse between the firing of the first and second torpedoes.

In his book entitled "The Submarine Warfare, 1914–1918," Vice-Admiral Andreas Michelson (retired), of the German Navy, presents the following German views of submarine attacks on hospital ships:

But we even torpedoed hospital ships? Yes, as many as three were unjustly torpedoed in accordance with the views then held by the naval staff, while a fourth case was indeterminate as the submarine in question did not return. Finally the Government was forced to permit the torpedoing of hospital ships

in the English Channel since these ships were held to have the same status as our own hospital trains behind the lines which were constantly attacked by the enemy aircraft or bombarded by their artillery. In a great number of cases the enemy bombed our field hospitals, which were well known for many weeks and plainly marked with the proper insignia, killing and wounding our hospital personnel. As a result of such unwarranted attacks one would have been justified in torpedoing any hospital ship wherever they were found as a warning and this should have been sufficient. For example, such torpedoing in the Mediterranean would have considerably hindered the enemy prosecution of the war, but one could not agree to such measures in spite of all the enemy violation of similar rights. We contented ourselves with laying a few mines in the areas outside the English Channel and two hospital ships were lost on these mine fields, while three or four others were sunk by submarines in violation of the rules for the conduct of war. Which of these were sunk purposely or which were sunk by mistake at night or in thick weather is not known to me; only one of these cases has been completely and fully explained. If such vessels were actually sunk purposely, then it is to be attributed to disobedience of orders on the part of the submarine commander concerned and such conduct can not only be explained as a result of the Baralong incident or the well-known cases of mistreatment of our submarine personnel when taken prisoner, but by the fact that these officers were convinced that the hospital ships were being misused by the English. We are constantly in receipt of information from returned prisoners and agents that these hospital ships were not only laden with wounded but that war material was being transported as indicated frequently by the deep draft of these vessels. One case of this kind is well known (torpedoing of a hospital ship on the basis of such information) where the case was brought to trial before the court in Leipzig as a result of pressure from the entente and which ended with the conviction of two "guilty parties." A sweeping criticism of this unjust conviction can be read in the book published by Dr. W. Hofacker ("The Leipzig Trials"). In any event this case was certainly no worse than the accidental bombing of a field hospital or a hospital train with shell or aerial bombs, an accident which was of frequent occurrence, which did not cause the air service to be discredited by the enemy or loosen a storm of indignant protest.

Regarding the violation of international laws by allied submarines it may be mentioned, according to the assertions of the Germans, that the Turkish passenger steamer *Stambul* (700 passengers) was sunk without warning by an English submarine, on May 5, 1915—two days after the sinking of the *Lusitania.* It is also alleged that other passenger steamers of the Germans were sunk in a ruthless manner in the territorial waters of Sweden, in the Adriatic, and in the Sea of Marmora.

The *Madeleine Rickmars*, flying the Red Cross flag and with 100 wounded on board, was torpedoed without warning.

On March 18, 1916, the Austrian hospital ship *Electra* was torpedoed in broad daylight off the Dalmatian coast by a French submarine. Admiral LaCaze, minister of the French Marine, explained this regrettable incident as due to the failure of the commanding officer of the submarine—on account of the low visibility—to detect the neutral status of the ship. When he discovered that the vessel

displayed the distinguishing markings of a hospital ship, he refrained from firing the second torpedo.

On August 16, 1918, Italian aviators bombarded the Austrian Red Cross hospital ship *Baron Call*, which had about 100 wounded men aboard. This lead to a letter of protestation, dated August 19, from the Red Cross Society of Austria.

The minister of the Italian Navy, in a note of October 21, addressed to the Minister of Foreign Affairs, which was transmitted to the international committee on December 31, explained the incident as being due to the failure of aviators to recognize the exact status of the ship.

Six Italian aviators, August 16, 1918, bombarded the port of Saint-Jean-de-Medua. In the course of this bombardment three bombs struck the Austrian hospital ship *Metkovich*, resulting in slight damage and wounding one Russian sick prisoner. The Hungarian Red Cross protested this violation in a letter dated September 26, 1918. The Italians in a reply attributed this attack to the inability of the aviators to observe the hospital markings of the attacked ship due to the high altitude at which they were flying.

B. MEDICAL TACTICS OF SHORE HOSPITALS

Standardization of equipment, supplies, and installations constitutes one of the fundamental principles underlying all military organization; for instance, the military personnel is attired "uniformly," carries specified equipment, and occupies standard type quarters.

During the World War the lack of standardized medical units—this deficiency can be readily attributed to the fact that there was no precedent to follow—was keenly felt by the medical officers upon whom devolved the responsibility of initiating and planning such establishments under the stress and pressure of other routine duties. As a result the number of types of war-time hospitals was almost equal to the total number organized.

The Bureau of Medicine and Surgery, recognizing the need of standardized war-time units, has now developed—based upon a study of the experiences of the past conflict—a series of 15 types of medical shore units—hospitals, dispensaries, etc. The plans for hospital facilities for use in a national emergency include:

1. *Navy base hospital*—500-beds capacity, capable of expansion to 1,000 beds.

2. *Station hospital*—100–200 beds capacity.

3. *Naval hospital*—existing institutions, of varying size, and capable of expansion to meet the local needs.

While it is considered necessary to prepare standards in time of peace, the complete adoption of such in time of war must not be

considered mandatory. All war plans are provisional in character, being subject to modification, alterations, or eliminations, in all or in part.

It is very likely that the Navy base hospital will be of tentage structure, which will be replaced gradually by "hutments." The station hospitals will probably conform to the type of emergency construction adopted by the Navy; but, in the event that any of them are placed in tropical or subtropical locations, the "hutment" type will prove economical and as a general rule preferable.

To give an idea of the bed requirements in war times, it may be stated that when the armistice was signed the total beds in hospitals manned by the Medical Department, United States Navy, amounted to 15,361, 9,442 of which were in east coast hospitals north of Hatteras (Bell).

In December, 1864, there were 187 Army general hospitals in operation, exclusive of the hospitals for the Confederate forces, having the enormous capacity of 118,057 beds. This gives an idea of the number of beds required for naval and military hospitals. With our country in a major war, over a half million hospital beds will be required.

Before considering the different types of shore hospitals, a few remarks will be presented concerning the evolution of naval hospitals and the agencies connecting the medical departments afloat with the medical activities ashore.

Historical—Military and naval hospitals.—As early as the second century A. D., there was an organized medical department with the Roman army, though physicians and surgeons, in a somewhat desultory way, had accompanied armed forces for centuries.

Xenophen (400 B. C.) mentions medical assistance with the Greek armies. In an order of Aurelian (270–274 A. D.) to his soldiers they were cautioned to conduct themselves quietly in the "hospitia"—failure to do so being punishable by a lashing. About this time the Romans prescribed, in the plans for winter quarters, a camp hospital. Some years previous to this, record is made of placing the wounded in their tents where they were visited from time to time by the general in command.

It is a rather well-known fact that the ancient naval vessels carried naval surgeons, yet there appears to be no definite record of distinct naval hospitals ashore. There is reason to believe, however, that the "sick and wounded of the navy were received into institutions erected by the Government for them, before the time of Hadrian" (Gatewood).

The first purely naval hospital was erected about 1666 in the priory of Saint-Eloy, when Colbert, minister of Louis XIV, founded Rochefort and organized the navy of France .

Only a comparatively few years later (1695) the partially erected palace of Charles II at Greenwich, England, was converted into a residence for aged and wounded seamen. It was not until 1756 that the first naval hospital was constructed along more modern ideas, when a London architect designed a naval hospital which was built at Stonehouse near Plymouth, England. Since that time naval hospitals have sprung up along the coasts of all civilized nations. "Born of no religion, the offspring of sheer necessity, they wait for the tocsin of war" (Gatewood).

Although the history of the Navy of the United States began as early as October 13, 1775, no attempt was made to establish naval hospitals until Congress passed the law of February 26, 1811, establishing these institutions. Shortly after the Revolutionary War there was no need for naval hospital facilities, as the American Navy practically ceased to exist when the last naval vessel, the *Alliance*, was sold in 1785. By July 16, 1798, Congress, realizing the need of institutions for the care of sick and injured seamen of merchant vessels, passed an act which was the beginning of the Marine Hospital Service. One year later this act was amended to include seamen of the naval service, who were cared for in the same hospitals with merchant seamen. As was to be expected, the scheme of divided control of naval patients did not work well, which is illustrated by the following letter.

In 1810 (February 22) Secretary of the Navy Paul Hamilton, in a letter to the chairman of the House Naval Committee, states: "The amount thus deducted (i. e., the 20 cents per month) paid into the Treasury, is $55,649.27, and there is a considerable sum deducted but not yet paid into the Treasury, and yet no Navy officer and but very few of the Navy seamen have received any benefit from it. * * * The inconveniences and embarrassments which arise from the placing of persons engaged under military laws in the public service in hospitals where no such laws exist have escaped the attention of Congress. In the few cases which have existed of any seamen being sent to such hospitals, experience has proved that the commanding officers of the ships from which they were sent would never get returns made to them, and that on an average three out of five have deserted as soon as they get into a convalescent state. Hence the propriety of having distinct establishments for the relief of sick officers, seamen, and marines of the Navy." He proposed many methods of securing income besides the tax on naval pay already in force. This prompted the act of February 26, 1811, establishing naval hospitals, and plac-

ing the construction of them under the supervision of a board of commissioners.

Unfortunately, nothing much was done by the board of commissioners (consisting of the Secretaries of the Navy, Treasury, and War Department) from 1811 to 1830 toward erecting permanent naval hospitals, thereby forcing the naval medical department to utilize temporary buildings. Thus in Philadelphia in 1813 a "wretched hovel," calculated to hold 8 patients but actually caring for, at one time, 24 patients, was used as a hospital. The patients remained only until they "could gather sufficient strength to desert."

The commissioners of Navy hospitals on May 1, 1824, purchased, as the site of the New York Naval Hospital, the Schenck farm, consisting of 33 acres of land with mansion and farm buildings. The purchase price was $7,650.

The naval hospital on Gray's Ferry Road, Philadelphia, was located on what was originally a tract of 150 acres, the site of a handsome country seat, belonging to the Pemberton family who purchased it from the Penns in 1753. The place was known as the "Plantation" and was a favorite residence for British officers during their occupation of Philadelphia. History records that the British flogged their soldiers, and hung one or two for depredation upon the gardens and smokehouses. From the Pembertons the place passed to the Abbots, who sold 23 acres to Surg. Thomas Harris, acting for the Government, in 1826; the purchase price was $16,000. The Pemberton mansion was used as a hospital building until 1833, when it was replaced by new buildings.

The navy yard, Portsmouth, N. H., was established in 1800, yet no provision was made for a hospital until 34 years later, when a vacant frame building, holding 10 patients, was allotted for this purpose.

Temporary quarters for the sick were established at Norfolk in 1811, while permanent construction was begun in 1832 upon the site of Fort Nelson. Twenty-five adjoining acres were bought from Col. Thomas Newton, then a Member of Congress, for $5,000.

The history of other naval hospitals is equally interesting, but time and space prevent further consideration.

The act of July 10, 1832, made the following appropriations for naval hospitals: Boston, $26,000; Brooklyn, $20,000; Pensacola, $30,000.

Contact between the medical formations afloat and the medical establishments ashore.—In order that there may be no weak link in our evacuation chain, measures must be adopted to connect the medical formations afloat with the shore medical establishments. The agencies to effect this contact consist of a heterogenous collec-

tion of ambulance boats and barges, ambulance trains, motor ambulances, etc. Some of these conveyances may be attached to the hospital ships, while others are a part of the land units; but, for the purpose of discussion, the miscellaneous conveyances utilizable between the hospital ship and shore hospitals will be considered under one heading. The last Hague Convention in article 5 makes provision for hospital boats and smaller craft used for medical purposes.

The eight ambulance boats attached to the New York Naval Hospital, between April 28, 1918, and March 22, 1919, transferred the following number of cases: Stretcher, 615; ambulatory, 9,472; contagious, 405; mental, 27; casket, 58 (36).

History records several instances of hospital ships being used in the communication zone for the evacuation of the wounded of land forces, as an example of which may be cited the excellent service rendered by the hospital ships during the Civil War on the Mississippi River. (The first extensive use of waterways for the evacuation of the wounded was at the siege of Metz, in 1552.)

The Motor Launch Department of the British Red Cross Society performed excellent service in Mesopotamia during the World War. Most of the motor ambulance launches were located at Basra, and were used to transport the sick and wounded between the various hospitals, also between hospitals and river hospital steamers, besides acting as "feeders" from hospitals to hospital ships. Some of these boats took positions near the front carrying the sick and wounded between field ambulances, casualty clearing stations, and the river head. They were also utilized to carry medical stores. One of the first boats carried over 20,000 patients besides several hundred tons of stores.

The north of France being rich in waterways, such as canals and rivers, hospital barges proved an ideal method of wounded transport. The barges used in groups of four, with a small tug supplying the motive power, were large and commodious, 120 feet long, 16 feet broad, and 10 feet high, and since plenty were available the newest were selected. Each barge had accommodations for 40–50 wounded.

The *ambulances flottantes* were found by the French to be most suitable means for transferring the wounded, as less jolting and shaking was caused by this method (37).

Small boats were used in tidal harbors and inland waterways of France to evacuate the wounded to larger hospital ships. This method shortened the train journey and thus saved unnecessary suffering, some of those wounded on Saturday, near Lille, reached London by midday Monday (38).

Motor hospital ships were constructed specially by the British to convey the wounded from the upper shallow reaches of the Tigris River to Basra. This type of hospital vessel was 160 feet in length, with 30-foot beam, and had the unusually light draft of 2 feet 6 inches. The ships were completely equipped with all the medical and surgical facilities for the care and comfort of the wounded (39).

To meet the needs of a link connecting the medical forces afloat with the land medical organizations, the British formed a separate branch of naval medical service and designated it "the Naval Medical Transport Department" (40). From the time a patient was landed until placed in a hospital he was under the care and supervision of the transport service.

The principal medical transport officer had an office in the Admiralty, while other medical transport officers were distributed at all places around the coast where wounded were likely to be landed. Temporary dressing stations and improvised hospital facilities, to accommodate patients while awaiting the arrival of ambulance trains, were maintained at principal naval ports. Emergency medical depots were established at other strategic points where sick and wounded would likely be landed, each depot consisting of "cot," "clothing," "hospital," and "medical" unit, respectively. The character of duty performed by each unit is indicated by the name; for instance, the clothing unit furnished supplies to persons suffering from immersion.

The Land Transport Department developed definite methods of disembarking and entraining the litter cases. One hundred stretcher bearers were assigned to unloading a hospital ship of the average size. The hospital corpsmen of the hospital ship brought the patients from the wards below via elevators, from which they were removed by stretcher bearers who carried them to the dock. From this place another litter squad carried them to the train, where the patients were entrained by still another squad. Of the 100 stretcher bears it was the custom to assign 30 to disembarking patients, 30 to transferring them to the train, and 40 to entraining duty. It required approximately three hours for 100 stretcher bearers to unload and entrain 400 cot cases.

The naval ambulance trains under supervision of the transport department were elaborately equipped with the necessary comforts and conveniences for the wounded (41). The train staff consisted of two medical officers and 36 men, who lived in the train.

The hospital trains of the United States Army are of two types, standard and improvised. Troop trains returning from the front may be temporarily converted into hospital trains to carry the less severely wounded. The standard hospital train consists of 16 coaches,

10 of which are ward cars, each train having a capacity of 360 stretcher cases, and 720 sitting.

The order of procedure adopted in this paper is to discuss the echelons of medical assistance in the order of their front to rear distribution, which arrangement places the station hospital and the Navy base hospital next on the list for consideration.

Station Hospitals

The experience of our medical service in the recent war has indicated that the use of civil hospitals for military patients is unsatisfactory, as the system of utilizing civilian organizations and institutions for such purposes involves dual control, and as such is in violation of basic administrative principles. It is highly probable in the next emergency that station hospitals will be established in many locations where civilian institutions have been previously employed. About 15 to 20 station hospitals will be required in the continental limits of the United States.

The station hospital is designed as a standard type of small emergency hospital for use in the United States. However, it is believed that under certain conditions this type of medical unit would prove more serviceable for use overseas than the larger type base hospital with its heavier equipment and, on occasions, may supplant it to advantage. Two or more of these units may be combined to make a larger establishment.

The layout of a station hospital is shown in the accompanying blue print prepared and adopted after a careful study of the plot plans of the various institutions utilized in the recent war. The equipment and supplies have been formulated from a compilation of the opinions of several members of the naval medical department.

Outline Description of Emergency Construction for Naval Hospital Buildings

(From data supplied by Mr. F. W. Southworth, of the Bureau of Yards and Docks)

Dimensions.—The width of the buildings is designed to be 24 feet, and of sufficient length to allow 8 feet, from center to center of patients' beds. The typical ward buildings will be about 140 feet long. The first floor of the buildings will be raised 3 feet from the ground and the height to eaves from floor will be about 10 feet, or 13 feet from grade.

Flooring.—Flooring in general for ward buildings, administration, and subsidiary buildings will be of wood, with the exception of kitchens, toilets, and lavatories, which will be of cement with a floor hardener. For the operating room suite, tile will be used if available; otherwise a concrete cement mortar finish with a floor hardener, similar to that used for the toilets and lavatories, will be utilized. Garage flooring will be of concrete.

Construction.—The construction will be of wood frame on concrete piers of simple design to permit quick and easy erection by unskilled labor. Sizes and lengths of timbers will be simplified to reduce the different types or kinds to

be used and to avoid confusion in erection. Partitions will be carried to ceilings, or where ceilings do not occur, will be carried to roofing.

Roofing.—Roof covering will be of a "ready roofing" type, composed of material similar to "Rubberoid," or crushed slate coated asphalt roofing. The roof covering will be placed on wood sheathing carried by the rafters. Ventilators will be provided for insuring circulation of air.

Walls.—Exterior walls will be of drop or rustic siding, and sheathing will not be used on the inside of exterior studding except in locations where heat insulation is required. Interior partitions will be covered on one side with wood sheathing. As an alternative, partitions may be covered with Celotex

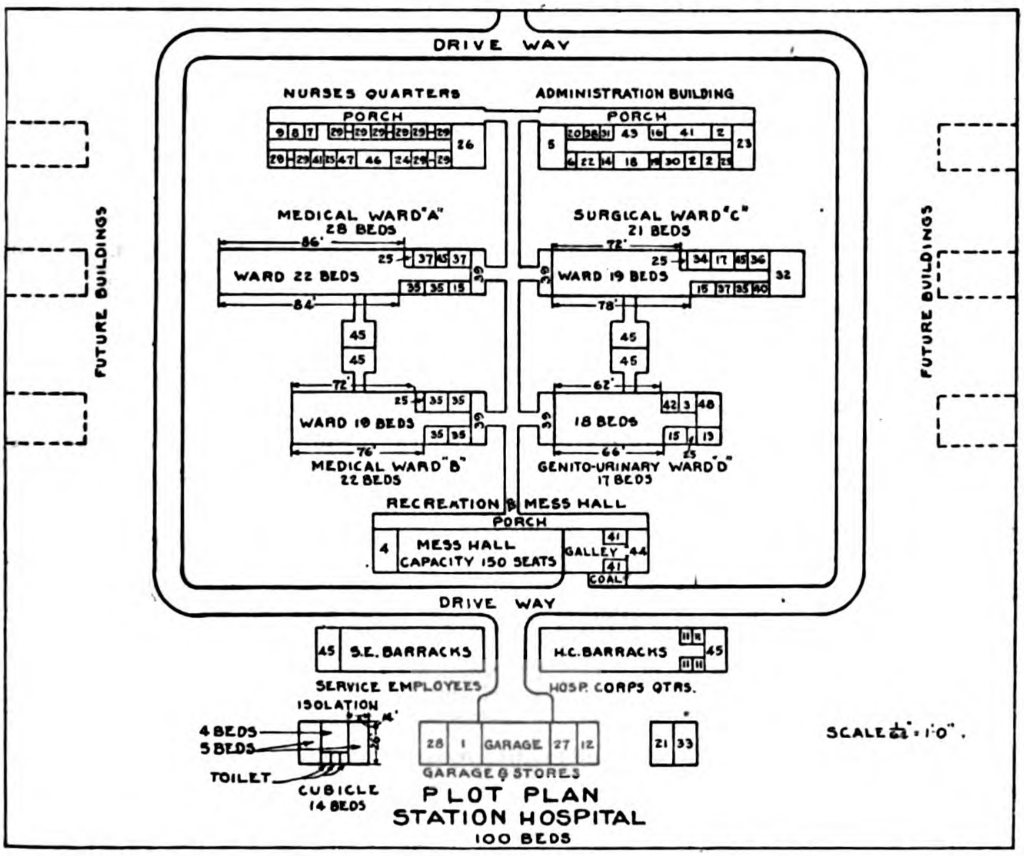

FIG. 13

1. Bag storage.
2. Bedroom.
3. Brig.
4. Central linen and sewing room.
5. Clerk.
6. Chief nurse.
7. Chief nurse's bath.
8. Chief nurse's bedroom.
9. Chief nurse's sitting room.
10. Closet.
11. Chief petty officer.
12. Commissary stores.
13. Dark room.
14. Dentist's office.
15. Diet kitchen.
16. Dispensary.
17. Dressing room.
18. Eye and ear.
19. Enlisted men's toilet.
20. Executive.
21. Fumigating room.
22. Junior medical officers.
23. Laboratory.
24. Laundry.
25. Linen.
26. Living room.
27. Medical stores.
28. Mortuary.
29. Nurses' room.
30. Officers' toilet.
31. Officer of the day.
32. Operating room.
33. Power plant.
34. Pus operating room.
35. Quiet room.
36. Scrub-up room.
37. Sick officers.
38. Senior medical officers.
39. Solarium.
40. Sterilizing room.
41. Stores.
42. Strong room.
43. Waiting room.
44. Special diet kitchen.
45. Toilet.
46. Toilet and bath.
47. Trunks.
48. X-ray room.

or a similar wall board. Celotex is manufactured from cane fiber, is a heat insulator, and sound-deadening material, about five-eighths inch thick.

Windows.—Windows will be of double hung type, of stock size, to be readily obtainable from commercial sources.

Hardware.—Hardware will be of easily obtainable, inexpensive commercial type, preferably galvanized or sherardized steel.

Painting.—Painting will be required for exterior work, and painting or varnishing for interior as the location and availability of material determine.

Heating and ventilating.—Heating will be done by steam from a central plant or boiler and main supplies will be probably carried overhead. In certain locations in warm climates it may be practicable to provide sufficient heat from stoves. Ventilation will be accomplished by means of ventilators in ceiling and through the roof, and by opening the double-hung windows.

Plumbing.—Plumbing will be of good grade commercial type, practically the same as required for the permanent construction.

Lighting.—Lighting will be of knob and tube work, except in instances where the fire hazard demands conduit installations. Lighting fixtures will be of standard type. Ceiling lights will be used in the wards and main rooms for general illumination, of the intensity required for each specific case. Ward lighting willl be augmented by means of wall brackets to provide required lighting for patients.

Incinerator.—An incinerator will be provided for the hospital, for burning trash and for garbage. It will be of brick construction or concrete, in accordance with designs developed to obtain the greatest efficiency.

Roads and walks.—The layouts for emergency hospitals are as compact as practicable, and main buildings will be, in general, connected by covered corridors. Roads and walks will be provided for the hospital reservation of a character to insure easy access to the buildings and to facilitate transportation of patients.

Composition.—The personnel of a station hospital consists of—

Medical officers	7	Nurse Corps	10
Dental officers	1	Hospital Corps	25
Pharmacist	1	Service Corps	25

A suggested method of distribution of the hospital staff is presented below as a general guide to the individual commanding officer in formulating his plans of administration:

1. Officers:	
Commanding officer	1
Executive officer	1
Surgical service	1
Genito-urinary service	1
Medical services	1
Ophthalmologist — Oto-laryngologist	1
Laboratory and X ray	1
Dental	1
Material; commissary	1
2. Nurse Corps:	
Chief nurse	1
Surgical ward	1
Medical ward	2
Isolation ward	1
Operating room	1
Linen room	1
Dietitian	1
Night nurse	1
Afternoon nurse	1
3. Hospital Corps:	
Chief pharmacist's mate (3)—	
Master-at-arms	1
Dispensary and medical stores	1
Commissary	1
Pharmacist's mate, first class (4)—	
X ray and master-at-arms	1
Genito-urinary ward	2
Property	1
Pharmacist's mate, second class (4)—	
Surgical ward	1
Medical ward	1
Night duty	1
Commissary stores and mess hall	1
Lower rating (14)—	
Medical ward	3
Isolation ward	2
Surgical ward	2
Eye and ear room	1
Operating room	2

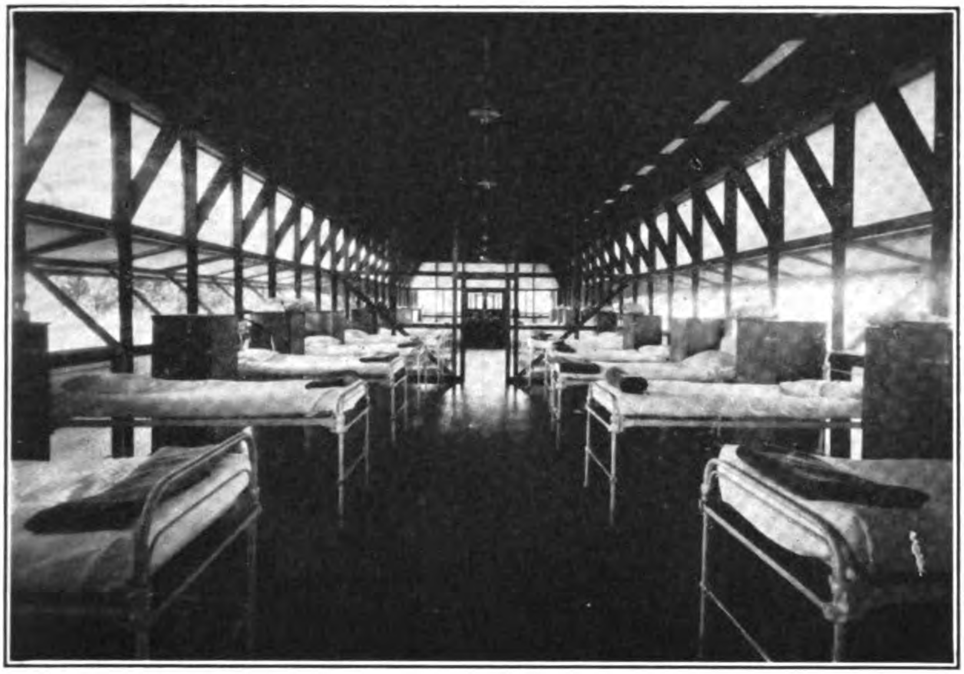

FIG. 14.—INTERIOR OF A 4-UNIT HUTMENT WARD CONSTRUCTED FOR EXPERIMENTAL USE AT NAVAL HOSPITAL, PEARL HARBOR, HAWAII

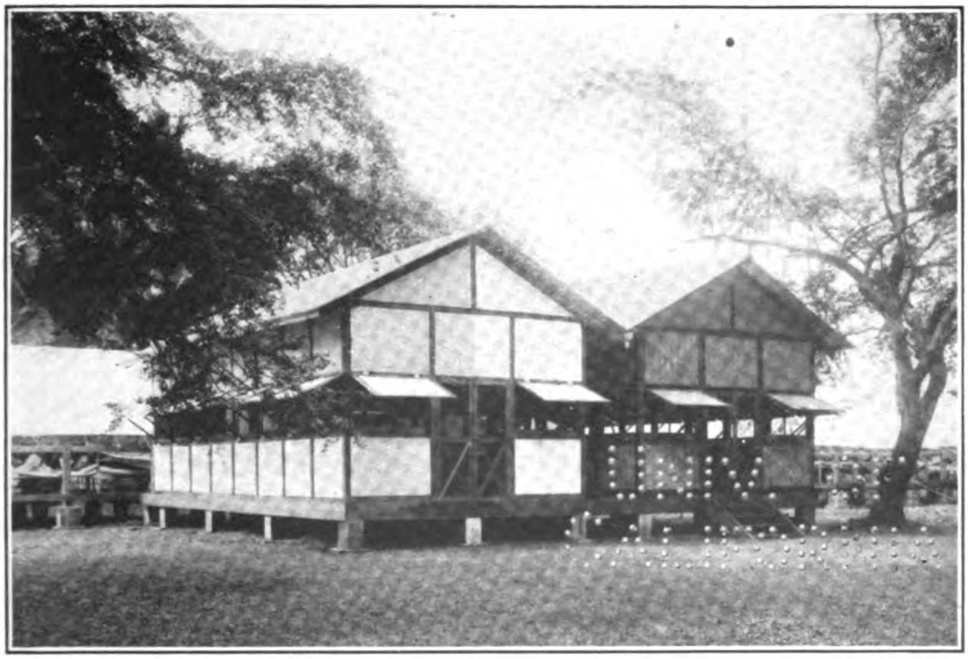

FIG. 15.—ONE=UNIT HUTMENTS AT NAVAL HOSPITAL, CANACAO, P. I. BUILDING ON LEFT HAS WALLS OF CANVAS AND WIRE SCREENING; ONE ON RIGHT HAS WALLS OF "SUALI" AND WIRE SCREENING

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3. Brig.
4. Carpenter shop.
5. Chaplain.
6. Chief medical officer.
7. Chief nurse's bed-room.
8. Chief nurse's office.
9. Chief surgeon's office.
10. Clean linen room.
11. Cubicle.
12. Commander's bed-room.
13. Commanding officer's bedroom.
14. Commanding officer's sitting room.

17. Corridor.
18. Commissary and supply office.
19. Dark room.
20. Dentist.
21. Diet kitchen.
22. Disinfector.
23. Dispensary.
24. Files.
25. Ether and dressings.
26. Eye and ear.
27. Executive office.
28. General office.
29. Hydrotherapy.
30. Instrument room.

room.
33. Laboratory.
34. Latrine.
35. Lavatory.
36. Library.
37. Linen room.
38. Living room.
39. Lieutenant commander's bedroom.
40. Lieutenant commander's office.
41. Medical officers' mess.
42. Medical officers' stores.
43. Mortuary.

(double).
46. Nurses' bedroom (single).
47. Nurses' sitting room.
48. Operating room.
49. Officer of the day.
50. Pay office.
51. Pharmacist's office.
52. Platform.
53. Plumbing and electrical shop.
54. Pus operating room.
55. Quiet room.
56. Scrub-up room.

58. Sick officers' mess.
59. Sitting room.
60. Small stores.
61. Stage.
62. Sterilizing room.
63. Stores.
64. Trunk room.
65. Waiting room.
66. Warrant officers' room.
67. Warrant officers' mess.
68. X-ray room.

3. Hospital Corps—Continued.	
Lower rating (14)—Continued.	
Genito-urinary ward	2
Laboratory	1
Night duty	1
4. Service Corps:	
Administration (4)—	
Stenographer	1
Reports and returns	2
Matériel	1
Commissary (12)—	
Cooks, first, general mess	2
Cooks, second, general mess	2
Cook, officers' and nurses'	1
4. Service Corps—Continued.	
Commissary (12)—Continued.	
Cook, special diet	1
Mess attendants	4
Maids, nurses'	2
Maintenance of buildings and grounds (7)—	
Carpenter	1
Plumber	1
Electrician	1
Laborers	4
Transportation	2
Chauffeurs	2

Navy Base Hospital

The navy base hospital, a medical unit evolved and used successfully in the World War, has been further developed by Capt. E. S. Bogert and Capt. H. C. Curl, Medical Corps, United States Navy. As a matter of historical interest it may be stated that an advanced base hospital was maintained at Syracuse by the Navy Medical Department during the first Barbary War. This hospital was abandoned at the end of the war in 1806 (Farenholt).

The regulations of the naval hospital in Syracuse promulgated on December 22, 1804, by Dr. Edward Cutbush (42) "of the Navy of the United States" contain prohibitions against spitting on floors or walls, smoking in wards, "suffering" women to enter hospital, throwing "nastiness" of any kind out of the windows, etc. According to these rules, patients were washed and had their hair combed on admission; face and hands were washed and hair combed daily, feet being washed "occasionally."

This type of medical organization is designated by the generic term, United States Navy Base Hospital, while each unit of this type is specifically differentiated by the serial number assigned to it by the Bureau of Medicine and Surgery.

The mission of the Navy Base Hospital Unit is to provide a portable and semi-mobile means of hospitalization for use in war time or under other emergency conditions where the special situation requires a temporary hospital facility capable of rapid construction.

Composition.—The officer personnel of a base hospital is as follows:

	Captain	Commanders	Lieutenant commanders	Lieutenants	Warrant
Administrative	1 (commanding).	1 (executive)		1 (supply officer).	4 pharmacists.[1]
Professional:					
Surgical service		1 (chief)			1 pay clerk.
General			2	2	
Orthopedic				1	
Genito-urinary				1	
Eye, ear, nose, and throat.				2	
Roentgenologist				1	
Medical service		1 (chief)			
Assistants			2	1	
Psychiatrist				1	
Dental service				2	
Laboratory service			1 (chief.)		

[1] Commissary, 1; general office, 1; first lieutenant, 1; material, 1.

There are several groups of naval medical reserve officers which have been organized to serve as nuclei of this type of unit, and it is planned in time of emergency to assign one of these units to duty with each hospital.

One chief nurse, two assistant chief nurses, with other nurses are included in the complement.

Subjoined is an itemized list of the personnel allowance of this type of medical unit prepared by Capt. D. N. Carpenter, Medical Corps, United States Navy. It is very likely that the commanding and executive officers of this unit will be members of the Medical Corps on the active list of the Navy, while the other officers will be drawn largely from the Medical Reserve Corps.

Enlisted personnel—Navy base hospital

Administration	No.	Duties required	Civilian occupation and symbol (trade specifications, U. S. A.)
(a) Clerical	21	Reports and returns. Requisitions and supplies. General correspondence and typing. Communications.	1 clerk, general office (38g); 2 clerks, special (38); 1 clerical worker (38b); 6 stenographers (39s); 1 typist (39t); 1 telephone operator (33o); 9 unclassified.
(b) Commissary	48	Supervision of stores, kitchen and mess hall; experienced cooking and baking; meat cutting; serving meals, dish washing—general cleaning.	2 caterers (40ca), 1 grocer (42gr); 1 merchant (42); 2 bakers (40b); 11 cooks)40c); 1 butcher (41b); 5 waiters (40w); 2 laborers (3); 23 unclassified.
(c) Discipline	3	Care of bag room; master at arms	3 policemen (82).
(d) Transportation	7	Repair and upkeep motor vehicles; chauffeurs.	2 auto mechanics (24g) 5 chauffeurs (22a).
(e) Power House	22	Operation and upkeep of engines, dynamo, boilers, piping system, plumbing fixtures. Includes laundry if operating.	1 electrician, dynamo tender (10gt); 2 electricians (10w); 1 machinist, general (6g); 4 enginemen and 4 firemen (17s); 1 blacksmith, general (7g); 1 plumber, expert (14p); 1 plumber, general (14p); 1 laundry manager (75lf); 5 laundry workers (75); 1 tailor (48t).
(f) Building and grounds.	13	General care and upkeep of buildings and grounds—trees, shrubbery, plants; animals; watchmen, and janitors.	3 joiners (8cb), 2 painters (13g); 1 teamster (27t); 1 gardener (64l); 3 policemen (82); 3 laborers (3).
I. Nursing	83	General care and nursing of patients in medical, surgical, venereal, and contagious wards. Sick officers—assistants and care of operating rooms and dental division.	40 nurses (43n), 43 unclassified.
II. Special departments:			
(a) Dispensary	4	Pharmaceutical preparations; medical storerooms.	3 pharmacists (43ph); 1 unclassified.
(b) Laboratory	3	Assistants and general care of laboratory.	2 chemical laboratory workers (67g); 1 unclassified.
(c) X ray	2	Assistants and general care of department.	2 skiagraphers (10x).
(d) Physiotherapy.	4	Administration of treatment and care of department.	2 hydrotherapeutists (43hy); 2 masseurs (43n).
(e) Linen room	4	Care and issue of linen	2 merchants (42c-42g); 2 unclassified.

Matériel.—The shipping weight of these assembled stores is 304,184 pounds, and they occupy 21,532.4 cubic feet—the above figures being exclusive of the motor transportation, provisions, biologicals, X-ray films, gasoline, and certain other articles the procurement of which is not deemed advisable until the services of the unit are required. The transportation comprises:

Ambulances (large)	2	Motor cycle (with side car)	1
Ambulances (small)	2	Trucks (one large, one small)	2
Touring car (5-passenger)	1		

Depending upon the destination of the unit, the character of the roads, and special mission of the respective organization, additional transportation facilities—such as horse-drawn ambulances and an ambulance boat—may be provided.

The Delco generator and water purification unit may be omitted from the equipment if the Bureau of Medicine and Surgery decides that these items will not be needed at the assigned destination of the unit.

All cases are marked with a single diagonal green stripe, and lettered "Base Hospital No. 1, U. S. Navy," (excepting the "A" stores which are marked with double diagonal green lines).

The outfit is classifiable as follows:

Deck storage.—"A" stores—Special items, needed en route.

Cargo storage.—"B" stores—Construction items; "C" stores—Equipment items; "D" stores—Medical, surgical, and hospital supplies, and special equipment.

The *deck stores*—as the term indicates—should be stored on the upper deck. They consist of a first-aid outfit, service outfit, information file containing allowance lists of matériel and personnel, blue prints, instructions, combination of safe, etc. It would perhaps be advisable to include the cases containing narcotics and alcohol in the deck stores in order to maintain supervision over these and prevent pilferage.

The *construction items* include—

(*a*) Tools (carpenter, plumber, electrician, and sanitation).
(*b*) Water-purification outfit.
(*c*) Delco outfit, complete.
(*d*) Materials for mess hall and galley.
(*e*) Tentage.

The *equipment items* are divisible into—

(*a*) Galley equipment.
(*b*) Mess-hall equipment.
(*c*) Office equipment.
(*d*) Ward equipment.
(*e*) Sanitation equipment.

The "*D*" stores include—

(*a*) Form "B" items (other than linen).
(*b*) Surgical and orthopedic supplies.
(*c*) X-ray and dark-room supplies.
(*d*) Dental outfit.
(*e*) Recreation material.

Provisions and all miscellaneous material should be placed under the above category. This classification has been presented in some detail, as the classes and subclasses above enumerated should be stowed aboard ship in inverse order, which arrangement will permit the unloading to take place in the direct order, as they will be needed to establish the institution, i. e., the *construction* items first, followed by *equipment*, and lastly the *supplies*.

Instructions for establishment.—It is impracticable to define specifically a fixed method of procedure, adaptable to the various conditions and circumstances which may arise, therefore, the following remarks are not intended to be final and complete. They are based upon a compilation of the opinions of several senior medical officers who had war-time experience with base hospitals, hence should be of value as a general guide in establishing this organization. The instructions may be discussed under the following headings:

(*a*) Activities prior to embarkation.
(*b*) Duties en route.
(*c*) Debarkation and unloading.

Upon receipt of his orders to command a unit, the commanding officer should assume all further initiative and request such further information as he may see fit. A pharmacist should be designated as matériel officer and another as personnel officer.

The executive officer should muster and assume charge of the incoming personnel, with special reference to subsistence, billeting, and discipline. Measures should be taken to eliminate before departure those who are considered physically unfit for the type of duty contemplated.

The property officer should see that the stores are loaded according to the instructions, i. e., in inverse order to that in which they will be needed on arrival at designation.

It may prove impracticable to carry out many of these points as it is not improbable that the personnel and matériel may be assigned to two or more transports.

While en route, the heads of the respective departments should utilize the time by presenting lectures to the subordinates of their department, and to developing a scheme of organization of each department so far as time and facilities will permit. The other responsible authorities can profitably employ the spare time at their disposal in working out a tentative outline of rules and regulations for such internal administration of the hospital as may come under their cognizance.

The executive officer should see that the health records are checked and that each member of the personnel is properly vaccinated.

Upon arrival at the destination, the commanding officer, or his authorized representative, should be among the first to land and carefully examine the hospital site (determining the most suitable locations for the tents, buildings, sanitary area, *et cetera*).

Officers and men not concerned with the location and construction of the hospital should remain aboard the transport until suitable provisions have been made to subsist and quarter the personnel.

The members of the Nurse Corps (female) should be among the last to disembark.

The pharmacist designated as "matériel officer" will supervise the unloading of the supplies and equipment. Fifteen tarpaulins are provided (case No. 1118) for the protection of the stores from climatic conditions.

Attached is a plot plan of a Navy base hospital, hutment type. This layout was developed to conform with a specified limited area, and a greater spread of buildings is desirable if more space is available. As a rough working rule, the space between buildings should be one and one-half times the height of the building. The plan, however, furnishes a general idea of an acceptable arrangement of buildings. Considerable time and study was devoted to the allocation of the internal hospital spaces in order to utilize such to the best advantage, and to apportion the same properly.

After the hospital site has been selected, plans should be made for the layout of the wards, living quarters, messes, and other buildings for which the attached plot plan should be consulted for an approved method of distribution of the various structures. The location of the individual buildings will necessarily be determined by the terrain, roads, and other influential factors.

In case the hospital personnel can be quartered and subsisted temporarily aboard the transport, and if there is an urgent need for wards for the reception of the patients, then the wards and kitchen should be the first to be set up. Under other circumstances, provisions should be made for the subsistence and quarters for the hospital personnel, prior to the setting up of the medical and surgical facilities.

Hospital structures.—The types of wards and barracks consist of:

(*a*) *Tentage.*—Forty tents, hospital ward, United States Army (16 by 50 feet) are provided to serve as wards under conditions where the time and other circumstances prevent the use of the following type.

(*b*) *Hutment.*—Buildings suitable for tropical use, and which will prove more serviceable for a semi-permanent institution than tentage, which deteriorates rapidly.

The hutments are intended gradually to replace tents for semi-permanent use, as they are found to be more economical and efficient than the former. Ward tents are supplied as they are capable of more rapid setting up and increase the mobility of this form of hospitalization. As soon as the probable duration of the sojourn of the hospital has been determined, the commanding officer should decide whether he wishes to replace all or part of the tent construction with the hutment type, and should requisition the material accordingly.

If the duration of the hospital is likely to be over a period of several months, the kitchens and mess halls should be of the hutment construction, and sufficient building material is furnished each hospital unit for the construction of a four unit building.

Prior to the construction of the hutment type of kitchens and mess hall, some of the ward tents may be utilized as temporary cooking and messing facilities.

The hutment is composed of units, the dimensions of each unit being 16 by 32 feet. Four units combine to make a ward for 30 to 40 patients, one or more being used to make smaller buildings.

The hutment type is, quite obviously, designed only for tropical and subtropical use. The hutment building consists essentially of a tar paper roof, wooden flooring, and sides composed of an upper and lower strip of canvas, with an intervening strip of copper wire screening. There are no windows, the wire screening completely surrounding the building, except for end doors, affords complete and free ventilation. A third strip of canvas is attached to hinged frames, and this may be closed over the wire screening as a protection of the interior from rain.

Naval Hospital

The existing naval hospitals are of varying size and are widely distributed in our continental and insular possessions, as is indicated so well in the adjoining table, prepared by Capt. A. W. Dunbar, Medical Corps, United States Navy.

This type of medical organization was designed primarily for peace time needs; or, better expressed, they appear, especially the older institutions, to have been established originally with little regard to providing facilities for expansion to meet the requirements of a war with a major naval power.

Patient capacity of United States naval hospitals

EAST COAST HOSPITALS

Hospital	Permanent		Wooden		Total	
	8-foot center	6-foot center	8-foot center	6-foot center	8-foot center	6-foot center
Annapolis	155	224	32	44	187	268
Charleston			33	39	33	39
Chelsea	384	645	272	482	656	1,127
Great Lakes	134	170	612	819	746	989
Key West	69	81		102	69	183
League Island			720	1,060	720	1,060
Newport	159	197	213	279	372	476
New York	1,092	1,707			1,092	1,707
Norfolk	547	687	94	113	641	800
Parris Island			161	219	161	219
Pensacola			190	240	190	240
Portsmouth	141	191	104	144	245	335
Washington	190	280	281	401	471	681
Total	2,871	4,182	2,712	3,942	5,583	8,124
WEST COAST HOSPITALS						
Mare Island			482	523	482	523
Puget Sound	143	178	110	130	253	308
San Diego	500	676	20	30	520	706
Total	643	854	612	683	1,255	1,537
INSULAR HOSPITALS						
Canacao			147	196	147	196
Guam			120	160	120	160
Pearl Harbor	179	238			179	238
St. Thomas			25	38	25	38
Total	179	238	292	394	471	632
TOTALS						
East coast	2,871	4,182	2,712	3,942	5,583	8,124
West coast	643	854	612	683	1,255	1,537
Insular	179	238	292	394	471	632
Grand total	3,693	5,274	3,616	5,019	7,309	10,293

Naval hospitals are fixed units, and serve as the last link in the chain of evacuation of naval casualties. It is to these institutions that the majority of those unfit physically for naval service—the insoluble residue resulting from warfare—eventually gravitate, are filtered out of the service, and thrown back into civil life. Naval hospitals support the advanced base hospitals and sometimes class A hospital ships. If the theater of operation is close to home ports the fleet hospital ships may evacuate to naval hospitals—direct or through the medium of medical transports—thereby eliminating the necessity of base hospitals.

On account of the lack of a uniform type of construction and layout, it is difficult to standardize completely these units; however, a

matériel allowance list, per hundred bed expansion, has been developed for war-time use.

The following personnel standard has been worked out by the hospital division of this bureau:

	Patients
Medical officer	1 to 30
Hospital Corpsmen	1 to 5
Nurse Corps	1 to 10
Civilian employee	1 to 5

The meager equipment of naval hospitals in early days is indicated in an inventory of property, taken May 2, 1815, of United States Naval Hospital, Washington, D. C. Among some of the articles included in this list are: Bedspread, 1 ("23 wanting"); towels, 6; feather bed, 1; urinal, pewter, 1; chairs, 6, etc.

BIBLIOGRAPHY

1. Pickthorn, E. B.: Hospital Ships, J. Roy. Army Med. Corps, London, 10:459, (May) 1908.
2. Kealy, A. G.: Hospital Ships, Army and Navy Gazette, Oct. 10, 1914, p. 392.
3. Chevalier: L'action de nos navires-hôpitaux pendant la guerre, Bull de l'Acad. de méd., Paris, 82:399, 1919.
4. Editorial: The French Hospital Fleet, Mod. Hosp., 10:56.
5. The Photographic History of the Civil War, vol. 10.
6. Bloodgood, D.: Yellow Fever on Board the U. S. S. *Jamestown*, store and hospital ship at Panama, Medical Essays, p. 177, Wash., 1872.
7. Pannet, C. A.: Use of Hospital Ships in Modern Warfare, Brit. J. Surg., 1914, ii, 459.
8. The *Castalia*, Hospital Ships, Am. Architect and Building News, 17:4, Jan. 3, 1887. Also Deep Sea Hospital Ships, Scientific American Supplement, No. 1444, No. 23134, Sept. 5, 1903.
9. Holcomb, R. C.: Hospital Ships, Reference Hand Book of Medical Science, Vol. V.
10. Neilson, J. L.: Hospital Ships for Fishing Fleets, U. S. Nav. M. Bull., 7:64, (Jan.) 1913.
11. Blackwood, N. J.: "The Angel of Mercy of the United States Navy," The U. S. Naval Hospital Ship *Mercy*, Am. J. Surg., 32:134, (June) 1918.
12. Braidwood, P. M.: Hospital Ship, Provincial Med. Jour., 14:285, Aug. 1, 1885.
13. McNabb, D. J. P.: Function of Hospital Ships, J. Roy. Army Med. Corps, London, (Feb.), 1912, p. 159.
14. Raison, T. W.: How Can the Hospital Ship Best Serve the Needs of the Fleet? Mil. Surgeon, 36:405, (May) 1915.
15. Warren, L.: Observations on Infectious Cases Treated in the R. N. Hospital Ship *Agadir*, J. Roy. Nav. Med. Serv., London, 3:221, (Apr.) 1917.
16. Nishi, I.: Hospital Ships and Transport of Wounded, Tr. International Cong. Med., 1913. Sect. xx, p. 17–32.

17. Elder, A. V.: A Note on Hospital Ships and Their Function, J. Roy. Nav. M. Serv., London, 2:443, (Oct.) 1916.
18. Straeton, R. J.: The Use of Hospital Ships in Time of War, U. S. Nav. M. Bull., 9:565. (Oct.) 1915.
19. Chambers, Joseph, Surgeon Vice Admiral, R. N.: Hospital Ships in Peace and War, Proc. Roy. Soc. Med., 18:1, (Dec.) 1924.
20. Sutton, E.: The Fitting Out and Administration of a Naval Hospital Ship, Wm. Wood & Co., New York, 1917.
21. Hyde, C. C.: International Law, Vol. II, Boston, 1922.
22. Chastang, M.: L'Organisation et Le Fonctionnement des Navires-Hôpitaux pendant La Guerre (1914–1918), Archiv de Medecine et Pharmacie Navales, (Feb.) 1920.
23. Taylor, J. G.: The Function of the Hospital Ship, J. Roy, Nav. M. Serv., 5:396, (Oct.) 1919.
24. Bell, W. H.: Naval Surgery, Chapter CXL, p. 748, of Vol. VI, Keen's Surgery, Philadelphia, 1908.
25. Handyside, P. B.: Hospital Ships and Their Workings in War and Peace, Lancet, Apr. 28, 1906, p. 1163.
26. Wise, J.: The Hospital Ship. Mil. Surgeon, 2:512, 1907; Editorial, 22:15, 1908.
27. Lomas, E. C.: The British Hospital Ships, Mod. Hosp., 1:55, 1918, also Brit. M. J., 1917, 542.
28. Report of the Secretary of the Navy for 1865.
29. Zur Verth, M.: Rettungsgerate auf See unter besonderer Beruck-sichtigung des Seekrieges, Archiv fur Rettungswesen, p. 481, 1917.
30. Hemsted, H.: A Combined Embarkation and Boat Distribution Scheme for Hospital Ships and Ambulance Transport, Lancet, ii, 382, 1918.
31. Abbott, W. J.: The Naval History of the United States, Dodd, Mead & Co., New York.
32. Mayo-Robson: An Improved Method of Lifting Patients on to Hospital Ships from Barges and Boats, Brit. M. J., vol. 1 of 1916, p. 10.
33. Withers, C. H.: Apparatus for Unloading Sick from Hospital Ships, J. Roy. Army Med. Corps, London, 24:278, 1915.
34. Barbier, T.: Les Navires-Hôpitaux et La Guerre de 1914–1918, Paris 1919. 1919.
35. Report of Proceedings Before the Supreme Court in Leipzig, H. M. Stationery Office, London, 1921.
36. Dickens, P. F.: United States Navy Ambulance Boats, U. S. Nav. M. Bull. Supplement, No. 13, p. 32.
37. Louvard, G.: Les Ambulances Flottantes, Ann. d'hyg., 28:307, 1917.
38. Barling, S.: Notes on Transference of Sick and Wounded Overseas by Ambulance Ships, Brit. Jour. of Surg., 1914–1915: ii, 455.
39. Editorial: Hospital Ships for the Tigris, Brit. M. J., No. 1, 819, June 16, 1917.
40. Porter, J. and Elder, A. V.: Account of Land Medical Transport Arrangements of the Navy, Brit. M. J., No. 1, 545, Apr. 28, 1917.
41. Pleadwell, F. L.: Naval Ambulance Trains Observed in Great Britain, U. S. Nav. M. Bull. 13:706, (Oct.) 1919.
42. Cutbush, E.: Observations on the Means of Preserving the Health of the Soldiers and Sailors and on the Duties of the Medical Department of the Army and Navy with Remarks on Hospitals and Their Internal Arrangements, Philadelphia, 1808. (The first (?) book published by a medical officer of the American Navy.)

The following references—included as a matter of record—contain data on the topics in the foregoing discussion:

Barney, C. N.: Japanese Hospital Ships (translation), Mil. Surgeon, 14:263, 1904.

Bellay, G.: L'Hôpital Flottant, *La Caravane*, Arch. de Med. Nav., 1:14, Jan., 1864.

Blackwell, E. M.: An ambulance motor boat for hospital ships, U. S. Nav. M. Bull., 9:637, (Oct.) 1915.

Blackwell, E. M.: The plan and description of a fleet hospital ship, U. S. Nav. M. Bull., 12:347, (July) 1918.

Blackwood, N. J.: The Hospital Ship *Mercy*, New York, M. J., 108:332, Aug. 24, 1918.

Braisted, W. C.: The United States Hospital Ship with some notes on hospital ships, Mil. Surgeon, 16:416, 1905.

Bridge, C.: The Art of Naval Warfare, (g) Medical Department of a Navy, p. 63.

Chitty, H.: A Hospital Ship in the Mediterranean, Brit. M. J., vol. 2 of 1915, page 529.

Collingwood, G. T.: Notes on the Work of a Naval Hospital Ship at the Dardanelles, J. Roy. Nav. M. Serv., 1915:315.

Cottle, G. F.: Transportation, The Supplement, U. S. Nav. Med. Bull., p. 17, (Apr.) 1919.

Current History, New York Times, 6:442.

Dalton, J. A.: Two Months' Work in the R. N. Hospital Ship *Rewa* at the Gallipoli Beaches, J. Roy. Nav. M. Serv., London, 2:1, (Jan.) 1916.

Eaton, W. E.: Conversion of Yachts into Ambulance Boats, Mod. Hosp., 36:81, 1914.

Gates, M. F.: What Would Be the Ideal Relationship of the Hospital Ship to the Fleet from the Standpoint of the Hospital Ship? Mil. Surgeon, 33:430, 1913.

Gradenwitz, A.: Floating Hospitals of Europe, Scientific Am., 113:398, 1915.

Holcomb, R. C.: The Navy's Hospital Ship, Mil. Surgeon, 40:76, 1917.

Holcomb, R. C.: A Hospital Ship for the Navy, Mil. Surgeon, 38: 556, 1916. 28:26. See also Mod. Hosp., 16:18.

Holcomb, R. C.: A Hospital Ship for the Navy, Mil. Surgeon, 38:556, 1916. Also ibid., 40:76, 1917.

Hole, K. H.: Some Experiences in a Hospital Carrier, J. Roy. Nav. Med. Serv. 1:159.

Horsfall, W. N.: Converting a Merchant Vessel into a Hospital Ship, J. Roy. Nav. Med. Serv., London, 10:92, (Jan.) 1924.

Hospital Barge, J. Roy. Nav. Med. Serv., London, 408–1920.

Kilbourne, H. S.: The Medical Department of the United States Army Transport Service, Mil. Surgeon, 12:1, 1903.

Lung, G. A.: What Would Be the Ideal Relationship of the Hospital Ship to the Fleet in Time of Peace? Mil. Surgeon, 33:314, 1913.

Marmion, R. A.: The Medical Corps of the Navy from the Outbreak of the War with Spain to the Present Time, Mil. Surgeon, 10:515, 1901.

Morton, B. S.: With the French Fleet of Mercy, Red Cross, 12:327, (May) 1917.

Ondard: Notes sur le fonctionnement des Navires-Hôpitaux, Arch. de Med. and Pharm., 102:355 (1915).

Pickrell, G.: Functions of a Hospital Ship, Mil. Surgeon, 26:52, (Jan.) 1910.
Pleadwell, F. L.: The Tenth Convention of the Second Hague Conference of 1907, U. S. Nav. M. Bull., 5:409, (Oct.) 1911, and 6:34, (Jan.) 1912. (There is an extended list of references appended to this article, W. L. M.)
Pleadwell, F. L.: The Relationship of the Hospital Ship and Medical Transport to the Fleet in Time of War, Mil. Surgeon, 33:316, 1913.
Potous, J.: Embarco and desembarco de heridos y enfermos a bordo de los boques hospitales, Rev. de San. Mil., 3, s. iv, 189 (1914).
Stokes, C. F.: The Hospital Ship as an Aid to Efficiency of the Fleet, Mil. Surgeon, 26:61, (Jan.) 1910. Also Med. Record, Aug. 14, 1909, and Medical News, Apr. 30, 1898.
Tissier, R.: LaCroix-Rouge Francois et Navires-Hôpitaux, pendant la Campagne de Chine, 1900–1901, Paris.
Wise, J. C.: The Status of the Hospital Ship in War, Mil. Surgeon, 19:142, 1906.
Zur Verth, M.: Hospital Ship, Mil. Surgeon, 30:429, 1912.
Zur Verth, M.: Das Lazarettschiff. Jena, Velag. Von Gustav. Fischer, 1920.

PART III

MEDICAL TACTICS OF AMPHIBIOUS WARFARE[1]

Before taking up the discussion of medical arrangements in amphibious warfare, a few preliminary remarks closely related to this subject will be presented.

Prior to taking the field, the naval medical officer, unless previously trained and experienced in field conditions, should carefully study the instructions and information contained in Landing-Force Manual; Manual for the Medical Department; Field Supply Table, Medical Department, United States Navy, 1923; Hospital Corps Handbook; and various articles appearing within the past few years in the Naval Medical Bulletin.

Field hygiene and sanitation is of the utmost importance. While the principles are simple of application, yet constant effort, supervision, and initiative on the part of the medical service is required for the proper enforcement of sanitary measures necessary to maintain the forces in requisite physical condition while operating in the field. To accomplish this satisfactorily requires attention to a "host of details, each trivial in itself."

George Whetstone, who was one of the first writers in the English language on naval medical conditions, wrote in 1598 of conditions in expeditions that have existed for centuries and nearly up

[1] The qualifying term "amphibious" is employed guardedly in this connection, its use following, as it does, a precedent long established. Amphibious literally signifies the capability of living in both media. As early as 1609, Ben Johnson speaks of a captain who had command both by land and sea as acting in an amphibious capacity. The advent of the use of airplanes as an instrument of war makes it advisable that some appropriate and descriptive terms be devised to cover the various combinations of aerial, terrestial, and aquatic types of warfare.

to the World War. "In the expeditions of our time to the southern parts, from whence in this and former ages the English have returned with renounced victory, yet exceedingly oppressed with extreme and penurious sickness, that hath much more prevented the preceding and performing of their pretentions than the power of enemies." Longmore, writing before the World War, states that, as a general rule, on expeditions four men perish from disease to one man lost in combat—a statement, however, not applicable to the recent struggle or to the Japanese-Russian War.

Casualty estimates should be considered carefully in making medical plans for a force in the field. Estimates of the type and number of sick and wounded to be expected under average conditions have been discussed in a previous article appearing in this Bulletin (19: 6, p. 803).

At Gallipoli the making of plans for clearing of the wounded was undertaken by an officer of the general staff, and the original plans allowed for no more than 3,000 casualties in the whole army. This number was considered an underestimation, and less than two days before the men were to start for the landing, "the medical arrangements were still entirely in the air" (Bean).

In consequence of the tardiness of all the medical arrangements of G. H. Q., neither two senior medical officers of the Anzacs ever received the final medical plans of Hamilton's staff.

A simple and efficient system of field medical supply is of paramount importance. As the late Captain Taylor of our service so aptly expressed it, "In the field the distribution of medical supplies, prompt evacuation, skillful first aid, shelter, food, and restoratives available early for each fallen combatant are of infinitely more importance than highly technical relief to difficult cases."

One of the recent lectures of Surgeon General Ireland, United States Army, contained an expressive phrase which it would be well to keep in mind. He used the words "simplification and improvement." It is sometimes an easy task to improve a procedure, method, process, or an apparatus, but in preparing for war, "Does it simplify?" should be one of the tests to be applied before any change is finally adopted. In war everything must be simple, but the simple is usually difficult (Clausewitz). Field medical supplies must be as simple in character and arrangements as efficiency will permit, yet the simple field supply table of a military organization has yet to be written, although it is hoped that the recent revision of the Navy's supply table is an approach in this direction. The new field medical equipment, devised and developed by the equipment laboratory (Maj. John P. Fletcher, M. C., U. S. Army, director) at Carlisle Barracks, Carlisle, Pa., represents the most recent ideas on this class of supplies.

The following remarks are based upon the Field Supply Table, Medical Department, United States Navy, 1923 edition, which was revised to accord with the lessons of land medical tactics of the World War, as studied and taught by the United States Army. If

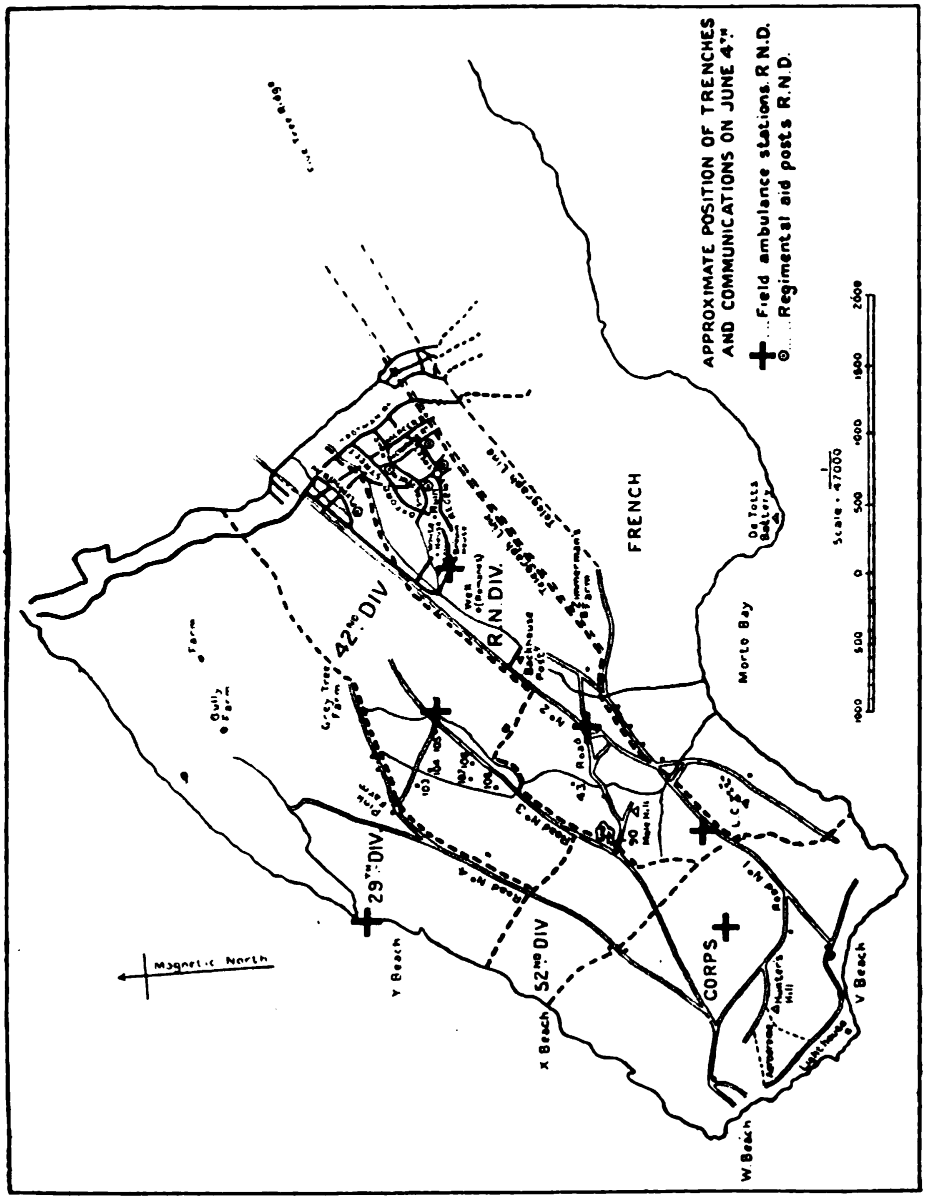


FIG. 17.—Medical stations of Royal Naval Division at Gallipoli. (After Gaskell. Reproduced from Journal of the Royal Naval Medical Service)

the Field Supply Table is referred to while reading this chapter, it should serve to make some of the following remarks more clear.

The question is often raised as to why the Navy Medical Department should develop its own medical organization and field medical supplies when this subject has been carefully studied and worked out by the experts of the medical service of the United States Army. It would greatly facilitate matters for the Navy to adopt the Army

medical organization and equipment. However, this involves a consideration of a fundamental principle:

The Naval Medical Department serving with the United States Marine Corps can pattern after and approach the Army medical organization and system of medical supplies, but unless the mission of the United States Marine Corps becomes identical with the mission of the United States Army, a difference in their two medical services must exist.

Landing parties and small wars constitute two types of operations which should be given primary consideration in the preparation of field medical supplies for the Navy and Marine Corps.

In the event that the organizations of the Marine Corps are brigaded or divisioned with an expeditionary force of the United States Army—such conditions occurred in France during the war of 1914–1918—then the former service becomes an integral component of the latter, adopting the same mission, organization, and equipment, with an identical system of medical supplies and installations. In the Dardanelles campaign the supplies of the naval division were pooled, by order of the expeditionary surgeon, with the other units.

In preparing the present system of naval field medical supply, an endeavor was made to arrange the items of the medical field outfits to meet the requirements of the various conditions with which naval medical units serving with combat organizations in the field are likely to be confronted. Such conditions may be termed and roughly classified as follows:

(*a*) *Naval landing parties.*

(*b*) *Organized modern warfare*, similar to the warfare of the World War.

(*c*) *Expeditionary service*, against semiorganized resistance, similar to the character of initial operations of the United States Marine Corps in the West Indies.

(*d*) *Occupational duty*, against an unorganized resistance, similar to the type of warfare in later operations in the West Indies.

It is believed that the arrangement of the medical outfits satisfactorily fulfills the tactical requirements of the first two types of operations.

It is assumed that in expeditionary warfare a regiment, or other combat unit, is likely to be variously divided for detached duty. In anticipation of this condition the following arrangement of medical supplies can be made:

(*a*) The individual equipment (items Nos. 1 to 4, inclusive) in "crisis expansion" serves to transport sufficient medical and surgical supplies for emergency treatment of any cases occurring in the

smallest detachments to which a member of the medical department may be assigned.

(*b*) Items Nos. 1 to 11, inclusive, were intended to provide sufficient medical and surgical supplies for *dispensary* and *infirmary* units of a regiment. The surgical roll in item No. 6 supplies the necessary surgical instruments to perform any of the ordinary surgical operations—surgery of head, trunk, or extremities. Utilizing these items, each regiment (1,673 men) is able to establish at least four of these dispensaries, which is believed to be the maximum number probably required for the detached components of a regiment.

The above remarks are applicable generally to an independent Infantry regiment, United States Marine Corps, provided with a "regimental medical outfit" and to the two component regiments of an independent Infantry brigade, United States Marine Corps, provided with their respective proportion of a "brigade medical outfit."

It is considered impracticable to arrange suitable outfits adaptable to all four conditions—without the addition of numerous additional items. As the occupational nature of a campaign is usually subsequent to the expeditionary features, it is believed that there is usually ample time to supply additional outfits to an expeditionary force in accordance with instructions of the Field Supply Table.

The mission of our field medical outfit is "To provide a selected assortment of medical and surgical supplies and equipment—assembled for immediate issue—sufficient to care for the normal sick and injured and battle casualties for a period of 60 days." After an expeditionary force has reached its destination, additional medical outfits and supplies will be forwarded by the next available transportation, in accordance with paragraph 4 of page 6 of Field Supply Table.

Assuming 1 yard of gauze or 1 ounce of cotton, with necessary bandages, as the amount of dressing material requisite for the average casualty dressing, we have calculated the dressing material available in each outfit, assuming 10 per cent of the total force to be wounded.

Type outfit	Total dressings available in outfit	Number of dressings per patient (assuming 10 per cent of total force wounded	Sufficient to dress wounded [1]
			Days
Battalion outfit for 547 men	1,034	19	57
Regimental outfit for 1,673 men	3,599	21	63
Brigade outfit for 3,969 men	13,985	35	105

[1] Assuming change of dressing every 3 days.

From the above table it will be seen that in order that the battalion and regimental outfits may have a surplus to carry out the mission, as stated above, it may be desirable to add items Nos. 37 to 39, inclusive, as a matter of safety.

The following suggestions are offered for consideration in the next revision of the Field Supply Table:

Repack the contents of battalion chest, medical, and battalion chest, surgical (gross weight, 135 pounds each), into four lighter containers, similar to the one now used for case, battalion dressing, item No. 7, as follows:

(1) Battalion case—medical.
(2) Battalion case—medical resupply.
(3) Battalion case—surgical.
(4) Battalion case—surgical resupply.

This limits the gross weight of each to 60 pounds and permits "one man carry" or pack-animal transportation, and gives flexibility and elasticity to the medical supply. The above cases (1) and (3) will contain sufficient supplies for march, maneuver, and detached service for brief periods of duration.

Eliminate wooden tongue depressors, wooden applicators, wooden splints, cocoa, first-aid packets (resupply carried by U. S. M. C.), colloidal silver (substitute solargentum tablets).

Increase quantity of magnesium sulphate, beef extract, emetin, gauze, cotton, ether.

Decrease quantity of foot powder, ointments.

Additional items.—Catheter, rubber, in hermetically sealed glass container.

Treatment of "gassed" cases.—Sufficient material is now available in the battalion cases for emergency constitutional treatment of gassed cases. Sodium bicarbonate should be added for local treatment of injured mucus membranes. Provision should be made for the Marine quartermaster to furnish chloride of lime or kerosene for local treatment of cutaneous injuries. The latter substance has been proved by experience to be one of the best remedies and solvents for vesicants. Copper sulphate should be supplied in 2 per cent aqueous solution for local treatment of phosphorus burns.

A Suggested Method of Distribution of Naval Field Medical Supplies to an Independent Infantry Brigade, United States Marine Corps

It is considered impracticable to define specifically a satisfactory method of distribution of the various items of a brigade medical outfit that will be adaptable to the different local situations which may arise. The distribution of the items—excepting the individual equipment—is largely a matter for the decision of the responsible medical officer, who will be guided by his estimate of the general and

special situations. The individual equipment—items Nos. 1 to 4 (inclusive)—will be retained by each individual in a state of readiness for immediate use.

On the march.—The "normal" regimental equipment consists of the following items which should accompany the regimental medical department at all times:

Item No.	Items	Number required	Item No.	Items	Number required
5	Battalion chest, medical	4	10	Tent unit, bedding	1
6	Battalion chest, surgical	4	11	Ten unit, furniture	1
7	Case battalion dressings	4	22	Field desk	1
8	Crate, litters	2	23	Typewriter chest	1
9	Case, blankets	1			

Each ambulance of the ambulance company should be equipped with litters, splints, and blankets.

Should the collecting company of the medical battalion establish march collecting stations, items Nos. 5 to 6 (inclusive) will be sufficient under ordinary circumstances.

On the march, or in the maneuver, the hospital company of the medical battalion may function in platoon formations, evacuating the cases to an accessible base, and under these circumstances items Nos. 5 to 12 (inclusive) and 14 will suffice to provide equipment for temporary hospitalization.

In a semipermanent camp.—In a semipermanent camp, each regiment would probably establish a "regimental dispensary" and the medical battalion would probably establish a "hospital station" for the administration of "definitive treatment."

Each regimental dispensary should be equipped with the following items:

Item No.	Item	Number required	Item No.	Item	Number required
5	Battalion chest, medical	4	[1] 17	Table, operating	1
6	Battalion chest, surgical	4	[1] 18	Chest, closed stool	1
7	Case, battalion dressings	4	[1] 19	Microscopical outfit	1
8	Crate, litters	2-8	[1] 20	Splint case	1
9	Case, blankets	2-4	21	Chest, books, medical, A	1
10	Tent unit, bedding	2-6	22	Field desk	1
11	Tent unit, furniture	2-6	23	Typewriter chest	1
12	Illuminating outfit, Prest-O-Lite	1	[1] 24	Chest, hospital stores	1
13	Illuminating outfit, extra tank unit	2	[1] 25	Case, medicine, B	1
			[1] 27	Chest, mess outfit, A	1
14	Chest, sterilizer	1	[1] 29	Case, surgical instruments	1
15	Case, dispensary, A	1	[1] 30	Case, embalming	1
[1] 16	Case, medicine, A	1	31	Dental outfit, portable unit	1

[1] Indicates that the items are used to establish a "regimental infirmary" when the unit is not in such contact with medical battalion as to utilize the hospital facilities of the latter.

The remainder of the items—not issued to the regimental medical department—will be retained by the medical battalion, for use of the

components in establishing a "hospital station" and those not employed for this purpose will be *retained in custody of the medical supply section of the medical battalion or stored in some available location.*

The items required for the establishment of a "station hospital" should approximate the items listed under "base hospital" in the following table, utilizing equipment sufficient to accommodate 50 to 100 patients.

In combat.—The following table is inserted as an outline of an approved method of distribution of items during operations of an independent infantry brigade.

If the lines of communication are short, or evacuation is rapid, an intermediate hospital station will not be required. If a hospital ship or other suitable hospital facilities are available for the administration of "definitive treatment" for normal sick and wounded, or for battle casualties, a base hospital station need not be established. Thus it will be seen that occasion may exist where only one hospital need be established.

Items not included in the following table, and surplus articles of other items, should be held in reserve or issued to base hospital station, as the needs may be.

Additional blankets for use during battles should be procured from the available Marine Corps supplies. Each ambulance should be equipped with a supply of blankets, litters, and splints, for exchange with the forward stations.

A suggested method of distribution of equipment to medical units for use during combat operations of an independent infantry brigade

(Item Nos. 1–4 for each individual officer and man. Company aid post corpsman should have a few extra coaptation splints from item No. 6)

Items	Battalion or regimental aid station, total for two regiments	Collecting stations for two regiments	Advanced hospital stations, medical battalion	Intermediate hospital, medical battalion	Base hospital station, medical battalion
Nos. 5, 6, and 7, battalion chest	8	2	1	1	0
No. 8, crate, litter	[1] 4	[1] 2	2	2	2
No. 9, case, blankets		4	[1] 4	[1] 1	([2])
Nos. 10 and 11, tent unit, bedding and furniture			[1] 2	[1] 2	([2])
Nos. 12 and 13, illuminating outfit			1	1	1
No. 14, chest, sterilizer			1	1	1
Nos. 15 and 16, case, dispensary, A; case, medicine A				1	1
No. 17, table, operating, small			1	1	1
No. 18, chest, closed stool				1	2
No. 19, microscopic outfit				1	1
No. 20, splint case				1	2
No. 21, chest, books, medical, A				1	1
Nos. 22, 23, field desk and typewriter			1	1	1
No. 24, chest, hospital stores			1	1	1
No. 27, chest, mess outfit			1	1	2
Nos. 25, 26, 29 to 43					([2])

[1] Or more. [2] As required.

Should an expeditionary force correspond in strength but differ in organization from the brigade as outlined in the official Marine Corps organization table—which was followed in the preparation of the field supply table—the force surgeon will distribute the items as he may decide.

The possibility of this variation in the organization of expeditionary forces from the official Marine Corps independent infantry brigade has been anticipated by allowing for a surplus of some of the items and by arranging for a multiplicity of some of the articles listed under the items.

Should an artillery regiment, signal battalion, engineer battalion, division, aviation, or other units join an independent infantry brigade to form an expeditionary force, outfits or parts of outfits in addition to the brigade outfit should be supplied.

It is not improbable that the first 11 items of the supply table will be sufficient for the attached medical troops of these combat units when the hospital facilities of a medical battalion are available; if not, then additional items in accordance with organization strength should be supplied.

Attention is invited to the fact that modern military organizations demand a higher standard of treatment on the battlefield and more prompt evacuation of the wounded.

Doctor Agnew, in American Medical Times, of October 4, 1862, page 493, estimates that 500 lives were lost at Antietam for want of proper transportation.

The Surgeon General, United States Army, in a letter written eight days after the battle of Bull Run says, "600 wounded still remain on the battlefield, in consequence of an insufficiency of ambulances."

Evolution of the Medical Aspects of Amphibious Operations

Amphibious warfare began with the earliest history of the human race. In the prehistoric times man undoubtedly used his dugout canoe as a means of transport to the scene of some combat on near-by shores. The fact that this form of transportation was used in that period is indicated by the discovery in England of dugouts of the stone age embedded some 25 feet below the earth's surface. From dawn of history to recent times, the records are replete with allusions to amphibious warfare, and it is very probable that the larger number of the expeditions were accompanied by some form of medical attendance.

The Roman expedition to Britain carried an eye specialist—one of the first allusions to a specialist in the medico-military profession.

The consideration of the medical aspects of amphibious campaigns involves a discussion of both land and sea warfare, and this appears a not inappropriate place briefly to sketch and tabulate some of the salient and interesting features of early sanitary measures employed for the protection of the forces, afloat and ashore.

The Phœnicians, famous for their navigation, did not make long uninterrupted voyages, but frequently debarked, remaining long enough to repair the ship, and to plant and harvest crops; hence, their crews were as a rule healthy and not subjected to dietetic disorders. In their voyage around Africa and return, this method of cruising was used.

Homer describes the excellent cleanliness and good order of the large vessels—"shipshape" being a term applicable to the state of naval sanitation even in ancient time.

The military value of sanitary measures was recognized from the days of the great conqueror Cyrus, whose father Cambyses, according to Xenophon, taught him that the prevention of diseases in camp was one of the most honorable functions of a general, while the office of treating diseases stood, relatively to it, as the office of repairing cast-off garments of the army.

Xenophon led successfully 10,000 Greeks through a cold and most inhospitable country by attention to the health of his soldiers.

Doctor Rush maintained that camp disease is not necessarily connected with the soldier's life, and cites as evidence to support this contention that the armies of ancient Greece and Rome were not only healthy, but had no diseases peculiar to themselves.

One of the first recorded regulations on the proper disposal of human waste products in the field is given in Deuteronomy XXIII, 12th and 13th verses.

Disinfectants.—Disinfection in some form or another has been used by the military and naval profession since the days of the ancients. Ulysses is said to have cleansed and scraped the place where he slew his enemies, and then to have burned sulphur over it. Sulphur fumigation of the holds of naval vessels has been practiced for the past several centuries. Lime, ferrous sulphate, carbolic acid, and sea water were in constant use on wooden ships as disinfectants. As late as the beginning of the last century, sprinkling vinegar on the deck of the sick bay was the prescribed method for sterilizing this compartment. Rush noted that fire and smoke of wood, the burning of sulphur, and the explosion of gun powder have a "singular efficacy in preserving and restoring the purity of the air."

Hospitalization.—The first regularly organized field hospital of modern nations was given by Queen Isabella to the force organized in 1485 at Quevada to fight the Moors. It consisted of six com-

pletely equipped tents, with surgeons and attendants. The first separate hospital for the wounded erected by a Christian government was built in 1552, during the siege of Metz.

Louis XIV established the first permanent hospital at the seat of war. Doctor Monro was one of the first to recommend an advanced mobile hospital, supported by one or more fixed installations to receive those from the forward hospitals. *Ambulances volantes* or flying hospitals were organized by Larrey during the Napoleonic campaigns.

The evolution and development of naval hospitals and hospital ships have been discussed in Part II.

Sick bay.—The present location of the sick bay seems to be a traditional arrangement derived from the galley period, through the French, thence to us through the English, who acquired many of their ideas of naval achitecture from captured French warships.

Fonssagrieves says that from all times the forward part of the ship was devoted to the care of the sick, an idea originating in the crude days when the sick were regarded as useless encumbrances.

The sick bay forward served the purpose of isolation in a period when the contagious and noncontagious diseases were not sharply demarked, since the only other place where the condition could obtain, the stern of the vessel, was occupied by the commanding officer.

Jean Marteilhe, of Bergac, relates that in the French royal galleys of the seventeenth and eighteenth centuries, the compartment in the bows, beneath the water line, close, dark and dismal, served the combined purpose of stowing cables and the medicine chest. Here, upon the cables, were piled the sick and wounded, and so great was the ensuing mortality that the wounded died like flies (Shippen).

M. Jal, writing of an earlier period, alludes to the hospital of the fighting galleys, then called "Tollar," from *tolerare*, to suffer.

A "sick berth" is a place temporarily screened off to accommodate the sick, while "sick bay" refers to a separate compartment. The terms are said to have originated "because they were places that made men sick."

Smollett's vivid picture of the sick berth in the middle of the eighteenth century is given below.

> * * * But when I followed him with the medicines into the sick berth or hospital, and observed the situations of the patients, I was much less surprised that people should die on board than that any sick person should recover. Here I saw about 50 miserable distempered wretches, suspended in rows, so huddled one upon another, that not more than 14 inches space was allotted for each with his bed and bedding; and deprived of the light of the day, as well as of fresh air; breathing nothing but a noisome atmosphere of the morbid steams exhaling from their own excrements and diseased bodies, de-

voured with vermin hatched in the filth that surrounded them, and destitute of every convenience necessary for people in that helpless condition.

In some of the British ships of that period there were no fixed sick bays, as the "Regulations" for 1757 state that a convenient place shall be set aside for the reception of the sick, " whither they are to be removed with their hammacoes and bedding when the surgeon shall advise the same."

Trotter, writing in 1804, says the apartments for the sick were very imperfect. It was because of his urgent recommendation that a definite plan was adopted. The improved sick berth designed by Captain Markham, and first constructed for the *Centaur*, was adopted as standard.

In 1810 the strong remonstrance against the impropriety of location of the sick berth caused the French to remove it from the lower to the upper deck.

It was in quite recent times that the British changed the location from the berth deck of double-decked ships. It appears that the American Navy, except on receiving ships, was still using the berth deck of double-decked ships as late as 1880, causing vigorous and urgent protests from naval medical officers, who regarded the place as the worst possible for sick men.

Fleet Surgeon Foltz, who served under Farragut on the *Hartford*, war largely instrumental in the adoption of iron standing beds secured to upright posts, in lieu of the former method of utilizing hammocks.

The cockpit in the United States Navy served as the location of the surgeon's mate until 1860.

Military rations, ashore and afloat.—The Greeks used a twice-baked bread in their rations. Pliny refers to *panis nauticus* used in the Roman Navy. The Roman generals are said to have substituted wheat instead of flour for the daily food of soldiers. Caesar fed his troops with wheat in his expedition into Gaul.

Cæsar Germanicus lost many from scurvy, and it is said that the herb, Cochlearia, called by the Latins *Herba britannica*, was successfully used as a remedy.

Food deficiency disease has had a most important bearing on the military success of amphibious campaigns, and one can sense the fact that early medical writers were almost but not quite aware of the action of accessory food factors. The " Colloquia Maritima " (Sea Dialogues), published in 1688, mentions that salt provision was the " one main cause that our English are so subject to calentures, scarbotes, (scurvy), and the like contagious diseases," and the substitution in the dietary of " husked hominy," and " loblolly " (made from maize) was recommended. Vitamine, as we now recognize

the prophylactic agent contained in lime juice, was used as an antiscorbutic by the Dutch in 1564, by Sir R. Hawkins in 1600, and was recommended by Woodall in his "The Surgeon's Mate" in 1636.

A British naval surgeon, William Cockburn, in his work entitled "Sea Diseases, or a Treatise of their Nature, Causes and Cure," 1696, points out that "green trade," i. e., vegetables, was a cure for scurvy.

The French used a form of cheese, which was preserved by exposure to moderately high temperature.

Huxham, in 1750, advised the drinking of cider and other acids of fruits, and sprinkled the well washed decks with vinegar.

It required 41 years for the British admiralty to put in enforcement Lind's recommendation (1754) for the compulsory use of lime juice for the naval force. This delay—it might be termed usual rather than unusual—was cited by Herbert Spencer as an apt illustration of the "inertia and torpor of administrative bodies."

One of the American medico-military writers of the Revolutionary War regards damaged flour as the "seed of many diseases," and it is inferred that he preferred whole wheat.

As early as 1807, "green peas soaked in water and allowed to vegetate" were used with excellent results by a naval surgeon as a treatment for scurvy.

Clothing and personal hygiene.—The ancient Roman soldier wore a flannel shirt next to his body, which material—as we know today—is about the only fabric which when saturated still permits passage of air through its substance.

General (then Colonel) Gage obliged his troops to wear flannel shirts, and "it was remarkable during a sickly campaign on the Lakes, not a single soldier belonging to that regiment was ever seen in any of the military hospitals" (Rush).

The soldiers of Xenophon and Hannibal used oil to anoint the body. Roman soldiers are said to have been required to take a cold bath daily.

Water.—Spirituous liquors were unknown to the armies of ancient Rome. These soldiers carried their canteens filled with vinegar which was diluted with water and drunk. The beneficial action of vinegar may be attributed to the partial sterilization of drinking water. As one writer—before the discovery of bacteria—expresses it, "the vinegar effectually resists that tendency to putrefaction to which heat and labor dispose the fluids."

St. Basil relates a method used by the ancient sailors to obtain drinking water from sea water. They boiled the water in large pots covered with sponges which were wrung out as soon as they were saturated.

Simons states that the drugs used to purify water included probably alum, bitter infusions, and alcohol.

In 1827, the surgeon of the *Altholl* recommended the use of lime as a general purifier of water and precipitant of organic matter.

The charring of water casks was rediscovered in later days in England as a method for the proper storage of water, which procedure was of much benefit to Cook in his long voyages. (According to Simons there are obscure paragraphs of ancient writers implying that water casks aboard ship were charred.)

Medical tactics of amphibious campaigns will be discussed under the following captions:

Section A—Naval Landing Parties,
Section B—Minor Warfare,
Section C—Marine Corps Expeditions,
Section D—Joint Army and Navy Operations.

SECTION A

Medical Tactics of Naval Landing Parties

Unfortunately, the tactics of naval landing parties have not been definitely and fully developed, at least the first book on this subject has yet to be written. One of the most extensive considerations of this phase of tactics, so far as could be discovered, was written shortly after the close of the American Civil War, and hence many of the principles will not apply under present tactical conditions. The subsequent remarks on the medical activities are based primarily upon the information contained in the Landing Force Manual, United States Navy, 1920.

Landing force organization.—The platoon is the unit of organization of naval landing parties, an Infantry platoon and an Artillery platoon consisting of six and four squads, respectively.

A company consists of two or more platoons.

A battalion comprises two to four companies; a regiment two to four battalions; and a brigade two or more regiments.

A capital ship's landing force has the following composition:

Platoons—marine Infantry	2
Company—bluejacket Infantry	1
Platoons—bluejacket Artillery	2
Special details.	

A synopsis of some of the special regulations promulgated by naval units for shore operations will be presented. As a general rule, these instructions do not specify definite medical arrangements and organization for landing operations.

The United States Fleet Regulations, 1924, prescribe that opportunities for assembly, landing, and exercise on shore of the landing forces shall be utilized as frequently as practicable.

References should be made to Battle Fleet Letter No. 69–25, File S79–4 (7826), dated October 22, 1925, for a different organization of naval landing parties, which will meet the "more probable exigencies" in which landing forces of this fleet may be employed. This letter states that such operations will demand great flexibility, maneuverability, and ease of subdivision, and that a guiding principle in an actual or simulated emergency is strength, composition, and equipment for task. The above points must be carefully considered by medical officers in making medical arrangements for landing parties.

The landing forces provided for in this circular consist of:

(*a*) The marine detachment of a battleship.
(*b*) The landing force of a battleship.
(*c*) The marine battalion of a battleship division.
(*d*) The landing force of a battleship division.
(*e*) The marine regiment of the battle fleet.
(*f*) The landing force of the battle fleet.

According to the battle fleet organization, the landing force of a battleship comprises the following units:

(*a*) Battalion commander and staff.
(*b*) Battalion headquarters company.
(*c*) Three Infantry companies.
(*d*) Machine-gun platoon.
(*e*) Artillery platoon.

The scouting fleet, likewise in a special letter covering this subject, specifies the organization of landing forces of this fleet (Scouting Fleet Regulations, 1926, par. 617).

The Regulations for Destroyer Squadrons, Battle Fleet, 1925, provide that destroyers shall be prepared to land three squads (one of which will be a machine-gun squad); the squadron flagship, two platoons; and the destroyer tenders, one platoon. The division commander acts as the battalion commander of the landing force; the commanding officers as company commanders; and gunnery officers as platoon commanders.

The Regulations of the Asiatic Fleet, 1925, provide for landing organizations for all ships, except submarines.

Medical organization for landing force.—According to the Landing Force Manual, the ambulance party of each battalion is ordinarily composed of "two stretchermen for each company, with a hos-

pital steward and as many hospital apprentices as the circumstances may demand."

In view of the fact that the rating of hospital steward disappeared some years previous to the last revision of the Landing Force Manual, the use of this designation indicates that the medical aspects of the 1920 edition have not been brought entirely up to date, so perhaps a few suggestions towards reorganization of the medical detachment would be advisable, and the following are offered:

(*a*) Two trained stretcher bearers for every 100 combatants or fraction thereof. If lines of communication are long, the number of stretcher bearers should be increased.

(*b*) One hospital corpsman, lower rating, for each company (or 200 combatants).

(*c*) The battalion medical detachment:

- 1 battalion surgeon.
- 1 pharmacist's mate (chief or first class).
- 2 pharmacist's mates (second or third class).

(Exclusive of company hospital corpsmen but including stretcher bearers as listed above.)

(*d*) Regimental medical department:

- 1 regimental surgeon.
- 1 assistant regimental surgeon (if regiment is operating independently.)
- 2 hospital corpsmen (1 chief or first class, and 1 lower rating).
- 2 to 4 battalion medical detachments.

(*e*) Brigade medical organization:

- 1 brigade surgeon.
- 1 pharmacist.
- 2 or more regimental medical departments.
- 1 advanced hospital—(to be supplied by hospital ship)—
  - 1 brigade surgeon (commanding, additional duty).
  - 1 pharmacist (additional duty).
  - 1 executive surgeon.
  - 2 junior medical officers.
  - 1 dental officer.
  - 1 chaplain.
  - 1 chief pharmacist's mate.
  - 2 pharmacist's mates (first or second class).
  - 8 lower ratings.

(*f*) Base hospital:

Hospital ship, or other vessel specifically designated to accomodate wounded.

According to the Battle Fleet organization, the medical detachment of a battleship landing force (15 officers and 270 men) comprises 1 medical officer, 4 pharmacist's mates (1 chief or first class), and 8 firemen acting as stretcher men.

Medical combat stations

Medical station and location	Composition	Function	Equipment
Company-aid post (directly to rear of company).	Company's hospital corpsman.	Apply tourniquet or compress to wound. Dress wound. Improvise immobilization for fractures. Prevent lightly wounded from leaving firing line. Direct ambulant wounded to battle dressing station.	Individual carrying device (item No. 1). Extra splints. Two canteens.
Battalion dressing station (300 to 500 yards behind firing line).	Battalion surgeon, 3 hospital corpsmen, stretcher bearers (2 per 100 combatants).	Redress, resplint and retag, if necessary. Morphine, A. T. serum. Hot stimulant and liquids. Blankets. Prompt evacuation.	Individual carrying devices. Battalion medical and surgical cases. Chest, battle dressing (items Nos. 1, 2, 3, 6, 7 and 9).
Regimental medical headquarters.	Regimental surgeon and assistants.	Tactical only, except when regiment operates separately, then regiment establishes a small rear hospital.	Equipment similar to above.
Advanced hospital. (Semimobile).	3 to 4 medical officers, 1 pharmacist, 1 dental officer, 1 chaplain, 11 hospital corpsmen.	Combat shock. Rest, food, surgical assistance. Evacuate to hospital ship, or other hospital base.	(Items 1 to 31 carried by hospital ship.)

Before landing.—Make physical inspection and eliminate unfit; examine and replenish field medical supplies, if necessary. Make a careful estimate of the situation and formulate a tentative outline for the organization and functions of the medical department. Study the regulations and instructions for landing force; study combat orders. The medical officer should be able to interpret a military map. For concise information on maps, refer to Chapter X of Landing Force Manual.

If time permit, give intensive instruction to the landing force on first-aid measures and field sanitary precautions. The stretcher bearers should be specially instructed and trained in transportation of the wounded.

Embarkation and landing.—The company hospital corpsmen should embark with their respective companies. This method will insure prompt first aid, and at least some collection of the wounded from the very beginning.

The force on landing should carry the lightest equipment possible. The packs should be carried in the hand on embarking and debarking. Landing through the surf is sometimes a difficut procedure. In landing through the heavy surf off Santo Domingo a sailing launch was anchored clear of the breakers and a line from it was drifted ashore and secured to a tree. By means of a lifeboat worked along this line, 600 men and several 3-inch guns were landed without an accident.

There is great danger of accidental discharge of firearms among landing troops, as is well illustrated by the following incident. Out of 22 cases of wounds among the marines comprising the landing

party in Guantanamo Bay, Cuba, on June 11–20, 1898, 10 out of the 22 casualties were due to accidental discharge of rifles, only 1 of which was caused by the premature discharge of a comrade's rifle. (Report of the Surgeon General, U. S. Navy, 1898, p. 178.)

Asst. Surg. John Blair Gibbs, United States Navy, the only American medical officer lost in the Spanish-American War, was killed in action at Guantanamo, while serving with the marine battalion.

Landing operations presuppose a relative and undisputed control of the sea, and this permits an open and uninterrupted line of communication with the supporting naval vessels, where medical replacements are available. It is therefore possible to adopt a principle of medical tactics somwehat opposed to the one outlined in the first installment of this discussion for the medical service on board ship during battle. In landing parties the stretcher bearers and battalion medical detachment must be mobile, and accept a certain proportion of combatant risk.

Evacuation.—If the landing force is small, the opposition slight, and the communication lines are short, the ordinary field litter carried by two stretcher bearers will suffice. If the lines of evacuation are longer, four bearer carriers must be resorted to.

Pack-animal, animal-drawn, or motor transportation may be commandeered shortly after landing, and devoted to evacuation purposes.

A two-wheeled litter carrier, which can be unshipped and stored in a compact space on board ship, is a most suitable method of transferring medical supplies to the front lines of landing parties, and evacuating the wounded to the rear medical station.

The type of warfare participated in by naval forces, after landing is effected, "partakes largely of the nature of minor warfare," which fact renders it logical to regard the succeeding section on the medical tactics of small wars as a continuation of this topic.

As the marines aboard ship are highly specialized and trained in landing operations and the tactical maneuvers of small wars, it is reasonable to assume that the first and second assault groups of the landing forces will be composed of Marine Corps companies and that the risk of losing the services of the highly specialized gun pointers, electricians, and other technicians will be minimized by permitting the bluejacket companies to form the support and reserve columns of the landing force.

SECTION B

Medical Tactics of Minor Warfare

Minor warfare has constituted in the past years an important function of the United States Marine Corps. Hence the development of the best methods of the employment of medical forces in this type of warfare is of the utmost importance to the naval medical

department furnishing, as it does, the medical units for this organization.

Campaigns in Cuba, Haiti, Santo Domingo, Nicaragua, etc., are striking illustrations of the small wars indulged in by this branch of the naval service.

In order that the medical officers may make a satisfactory disposition of the medical troops and otherwise cooperate with the Marine Corps, it is essential that they be conversant with some of the fundamentals of the tactics underlying minor warfare. The special situations which may arise in this type of operations are so varied that it appears impracticable to formulate specific rules for the employment of medical forces. It is therefore believed that an outline of the tactics of minor wars, with a few remarks on disposition of medical troops, will suffice for the purposes of this paper.

Minor warfare involves (*a*) *regular operations*, when the troops of both sides are organized and trained, or (*b*) *irregular operations*, which consist of minor actions against unorganized or partially organized forces.

In the majority of irregular actions, especially those against an uncivilized enemy, members of the medical service should discard brassards, and other Red Cross insignia, and carry arms, both for their own protection and for protection of the sick and wounded.

As a general rule the conduct of minor wars may be divided into three stages, namely:

1. Landing operations.
2. Seizure of a city.
3. Operations in the field.

The landing may be on the waterfront of the city, or on the beaches adjacent, more likely the latter if much opposition is anticipated. It is said that the element of surprise is gained by attacking a city in daylight.

The troops attacking the city are divided into two forces:

(*a*) The *covering force* which skirts the city, avoiding street fighting, and thus surrounds and cuts off the city from reinforcements.

The "company" hospital corpsmen should accompany this force, and as many of the other medical personnel as can be spared should proceed well in rear of the "occupying force," for the purpose of establishing a hospital in the first available building selected.

(*b*) The *occupying force* proceeds to clear away all opposition in the city by house-to-house-fighting. The force assigned each street is divided into.

1. Street detachment.
2. Roof detachment.
3. Searching detachment.
4. Main body.

The company hospital corpsmen should proceed with the main body. The remainder of the battalion medical detachment should be stationed with the "battalion support" or in the rear of the same. The necessary measures should be taken to keep the battalion commander and the company's hospital corpsmen informed of the location of the battle dressing station.

The third stage of minor wars usually comprises operations in the field somewhat similar to the activities of the marines in Haiti against the "Cacos" in 1919. In this stage, resistance is apt to be offered only by the more ignorant and less organized class of rural natives, who are governed largely by their emotions, and all emotions are temporary.

Savages and semisavages are addicted to cruelty. The capture of the dead may raise the morale of the enemy, and this requires special precautions to protect the dead as well as the wounded. Among the Cacos of Haiti the superstition existed that the heart of an American soldier, if eaten, would make the eater immune to bullets. At least one heart was so eaten.

Fighting against savages, Asiatics, Red Indians, and foes of that class, the responsibility for safeguarding the troops who may happen to be placed hors de combat is a perpetual source of worry to the commander. Nor does this difficulty arise only when campaigning against uncivilized races. In guerilla warfare in civilized countries the wounded can seldom be left to the tender mercies of the peasants in arms. Civil strife is demoralizing and leads to pitiless reprisals on the part of soldiery and insurgents; the partisan warfare in La Vendee in the Peninsula, and in Cuba was marked by the utmost ferocity on the part of the guerillas. (Caldwell's "Small Wars," 1906.)

Evacuation.—In small wars, especially after the larger cities have been seized and field operations have been instituted against small semiorganized detachments, the transportation of the wounded becomes increasingly difficult. It is very likely that irregular warfare will be indulged in, and consequently no respect will be given the requirements of the Geneva Conventions, thereby causing the medical forces to be armed and to accept combatant risks.

With small detachments even one casualty often causes serious distraction from the fighting force as illustrated by this instance. In the Haitian campaign a patrol consisting of one officer and 19 men, including a naval hospital corpsman, fought a running fight with the enemy to Le Trou and return. One man was wounded, which required 20 per cent of the detachment to carry him on an improvised litter.

"But quite apart from their being one of the many causes which necessitate the maintenance of communications by regular troops in the field, the presence of wounded, and often of sick, will sometimes seriously hamper the strategical freedom of an army in this class of warfare."

It is impracticable to carry the Army litter in the type of warfare existing in the hills of Haiti a few years ago. Improvised litters must be used or else a special type litter may be specially designed. The Gwin Flex stretcher proves a very suitable device for the transportation of the wounded in guerilla warfare. This apparatus weighs 6 pounds, and has the following dimensions when rolled and folded in its carrying case—34 inches by 9 inches by 4 inches, totaling 1,224 cubic inches.

The scene of the closing days of a minor war is apt to be in the rugged fastness of mountainous regions or other isolated regions where the insurgents are making their last stand. Under such conditions pack-animal transportation of medical supplies must be resorted to.

Retreat after a reverse at the hands of such antagonists is generally rendered particularly awkward by the necessity of carrying off the wounded. This is of course always indispensable when fighting against uncivilized forces. It constitutes one of the greatest difficulties which regular troops have to contend with in hill warfare. It is also a serious impediment to their operations in bush warfare, and even in open country the presence of a convoy of wounded with an army retreating in face of adversaries who massacre all who fall into their hands, greatly aggravates the anxieties of a situation which is, at the best, an unfavorable one. It is always desirable, when it can be done with safety, to send off the sick and those who have been placed hors de combat in action well in advance before the retirement commences. But if the enemy be in a position to envelop the flanks or to strike in on the line of retreat, or if, as was the case at Maiwand and Adowa, the people of the country through which the withdrawal takes place offer hostility, it is obviously unsafe to detach the helpless from the immediate protection of the army. It may even be necessary to adopt the awkward square formation in such a case, and the retirement of the whole force is sure to be retarded very seriously. (Callwell's "Small Wars," 1906.)

For the protection of the wounded, the square formation is generally used, regarding which Callwell says:

The raison d'être of the square, whether it be used as an order of march, as an arrangement for bivouac, or as a formation for battle, is to be found in the necessity which may be at times imposed upon a body of regular troops of being able to show a fighting front in any direction, and in the obligation which it incurs of protecting its supplies and wounded. In its military sense the term does not necessarily mean a rectangle of four equal sides. It simply means a formation showing front to flanks and rear as well as to the proper front.

SECTION C

Medical Tactics of a Marine Corps Expeditionary Force[1]

Outline

1. Attached medical troops:
   (a) General considerations.
   (b) Organization.
   (c) March.
   (d) Combat.

[1] The major portion of this section was prepared by Lieut. Commander W. A. Vogelsang, Medical Corps, United States Navy (W. L. M.).

1. Attached medical troops—Continued.
   (e) Company medical detachment.
   (f) Battalion medical detachment.
   (g) Headquarters medical detachment.
2. The medical battalion:
   (a) Organization.
   (b) Functions.
   (c) Principles of operation.
   (d) Collecting company.
   (e) Ambulance company.
   (f) Hospital company.
   (g) The Service company.
3. Supporting medical and hospital facilities:
   (a) Base hospital.
   (b) Medical supply depot.

It is quite well known that the Naval Medical Department serves as the medical service to that amphibious organization—the United States Marine Corps. Consequently the Naval Medical Corps must be prepared to function in both land and sea warfare. In whatever part of the world the Marine Corps units may be located, medical detachments of the Navy will be found serving the medical needs of the Marines.

The record of the medical officers and hospital corpsmen serving with the Marine Corps brigade in France during the World War is one to which we can look backward with pride, and may be pointed to as sufficient evidence to justify the statement that the Naval Medical Department has always fulfilled its mission with the Marine Corps, and will endeavor to live up to this reputation.

In the former days the Marine Corps organization taking the field was usually composed of an infantry battalion, regiment, or brigade acting independently. The development of aviation, motor transportation, and other requirements of modern warfare causes it to be most likely that future operations will be conducted by a more heterogeneous organization, usually known as a "force."

The senior medical officer of an expeditionary force of the United States Marine Corps is termed the "force surgeon" and will serve on the staff of the force commander.

1. Medical Attached Troops

General considerations.—The term "medical attached troops" designates the medical personnel attached to and serving combat units. In battle the success of the medical department depends upon the initiative, judgment, and proper application of the principles of medical tactics on the part of regimental and battalion surgeons. Medical tactics are based on line tactics, therefore medical officers assigned to duty with troops should have at least a working knowledge of the type of tactics of the troops which they serve.

Without such knowledge they can not expect to function efficiently as members of the military team.

Infantry being the most important component of any military force, the tactics adopted by the medical attached troops serving an infantry regiment, United States Marine Corps, will be discussed. Inasmuch as battles are won only on the offensive, the defensive being purely an incident in any campaign, this discussion will only consider the details of the former. Generally, in defensive situations medical department stations are more or less stabilized; the treatment of casualties is more elaborate, in that certain types of operations can be performed at advanced stations; routes and schedules of evacuation are fixed, and logistic requirements can be calculated with some degree of accuracy. During an offensive, on the other hand, these conditions are reversed, the greatest difficulty being experienced in the collection and evacuation of casualties and in the replenishment of advanced stations.

Organization.—The medical attached troops serving with an infantry regiment, United States Marine Corps, consist of the following officers and men:

Regimental surgeon, lieutenant commander, M. C., U. S. N.

Assistant regimental surgeon, lieutenant, M. C., U. S. N.

Three battalion surgeons, lieutenants or lieutenants (j. g.), M. C., U. S. N.

Dental surgeon, lieutenant or lieutenant (j. g.), D. C., U. S. N.

Total commissioned, 6.

Enlisted, H. C., U. S. N., 32.

While in camp this entire detachment is commanded by the regimental surgeon who is responsible to the regimental commander for its training and proper administration. During the march and in combat the detachment is divided as shown below, the regimental surgeon losing administrative control of all personnel except those serving in the headquarters medical detachment.

Headquarters Medical Detachment

Regimental surgeon.

Assistant regimental surgeon.

Dental surgeon.

Five hospital corpsmen.

The Battalion Medical Detachments

Each consisting of:

One battalion surgeon.

Nine hospital corpsmen.

(For detailed organization of detachments for combat purposes see chart.)

Disposition for the march.—The regimental surgeon as a member of the regimental technical staff marches with the regimental commander. The remainder of the headquarters medical detachment march at the rear of the regiment. Battalion surgeons may march with their respective battalion commanders, but usually take position in rear of their battalions in order better to observe the physical condition of the troops. The battalion medical detachments follow the battalions.

Duties during the march.—The regimental surgeon must keep himself informed of the situation and accompanies the regimental commander on such reconnaissances as the latter may make. He keeps in touch with the battalion surgeons, receiving from them reports as to the physical condition of the troops and makes such recommendations to the regimental commander as may be consistent with the situation.

Battalion surgeons examine march casualties as they occur and decide whether a man is fit to continue the march fully equipped, whether he shall be relieved of his pack, or whether he is ill enough to require transportation. At the hourly halts they supervise sanitation and warn all against obtaining water except from authorized sources. They must also keep in touch with the military situation through frequent consultations with the battalion commanders or the battalion operations officer.

In combat.—When battle becomes imminent the battalion surgeon assigns one hospital corpsman to each rifle company and one to the machine-gun company. If this company supports the battalion attack as a unit one hospital corpsman will be sufficient; usually however, the company is divided, one platoon supporting each flank, and in that case one corpsman should be detailed with each platoon. The remainder of the detachment operate the aid station when established and serve as litter bearers.

The regimental surgeon assigns at least one man to act as contact agent with regimental headquarters. The remainder of the detachment operate the aid station should it become necessary to establish the same. He requests that the band be detailed to serve as litter bearers.

One of the chief functions of the headquarters detachment is that of a reserve of personnel and matériel, and for this reason the regimental aid station is not established unless the situation warrants it. In offensive operations the regimental aid station ordinarily is *not* a link in the chain of evacuation.

Before discussing the tactics of these groups in detail certain fundamental principles of medical tactics will be laid down.

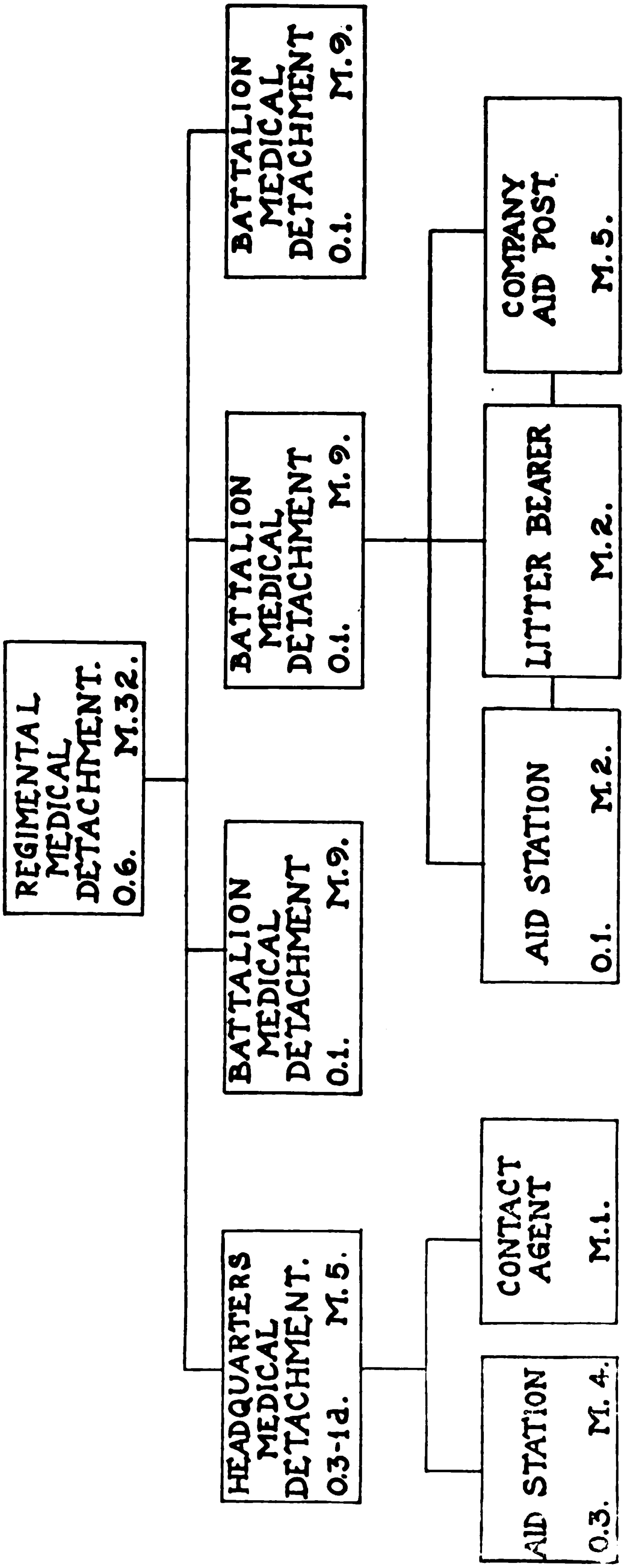


FIG. 18.—Chart of the distribution of medical troops attached to an infantry regiment

First. Medical personnel attached to the components of a regiment during the march remain with the unit to which attached and serve it during battle.

Second. Contact is established and maintained from rear to front.

Third. A unit evacuates casualties no further to the rear than its own station.

The above principles should be adhered to as closely as possible.

The company medical detachment.—The corpsman assigned to this duty advances with the company. He takes position in the vicinity of the platoon in support. During the advance he does not establish any sort of station, but administers first aid to such casualties as may occur and moves them to the axis of advance of the company to be picked up by the units to the rear. Should the line be held up for some time, and this usually happens as the assault position is approached, he picks out some protected spot and establishes a company aid post about 100 yards behind the front line. Here he applies dressings, controls hemorrhage, and directs such wounded as are able, to walk to the rear.

The battalion medical detachment.—This detachment, less those assigned to companies, advances in the axis of the battalion, dressing, redressing, and moving the casualties from the axis of the company to that of the battalion. Aid stations are not established until the line has been definitely held up or the number of casualties warrants it. It must be remembered that the greatest number of casualties will occur from the time the assault is launched until the enemy is driven out and the position taken. Therefore, to establish stations during the advance or before the situation demands it is a tactical error.

As soon as the station is established the first duty of the battalion surgeon is to make contact with the company aid posts. He does this through his litter bearers, who then begin the evacuation from this post to the battalion aid station. Here the wounded are retained until the litter-bearer elements of the collecting company can come up and begin the evacuation to the rear.

The attention wounded receive at battalion aid stations is limited. Hemorrhage is controlled, splints are applied, and wounds are dressed or redressed. Morphine is administered to such as require it, tetanus antitoxin is given, treatment for shock is instituted, and such hot drinks as are available are administered. No operations are performed except those necessary to save life. Casualties are tagged and a record is kept of all who pass through the station.

The requirements for a battalion aid station in order of importance are shelter, water, and wood.

Shelter is the paramount consideration. Sufficient defilade must be secured to protect from aimed rifle and machine-gun fire. A ravine, shell hole, dugout, or the rear of a slope all offer shelter. Buildings, cellars, or churches are also excellent places, and these, in addition, offer protection from the weather. These stations are located from 300 to 800 yards from the front line, depending on the formation. In general, they should be about the same distance behind the front as the company in reserve, but not in the same location, as reserves are sought out by enemy artillery and machine guns.

Proximity to water supply is important and a site on a stream or near a stream should be selected whenever practicable.

Wood for fuel is desirable, but not essential.

The headquarters medical detachment.—Casualties occurring among the headquarters troops will have to be cared for by this detachment. The regimental surgeon should be free to visit the battalion aid stations in order to observe their progress. As stated above, this station is ordinarily not established, the personnel attached thereto acting as a reserve for the battalion detachments.

During the advance the headquarters detachment follows in the axis of the regiment, care being taken not to get too close to the battalion in reserve, as this will be sought out by the enemy. The detachment gives such first aid as is necessary, the litter bearers being used to move casualties from the battalion axis to that of the regiment. Should it become necessary for one of the battalion surgeons to establish station due to a great number of casualties occurring during the advance, the regimental group will replace it until such time as the battalion surgeon can clear his station, pack up, and rejoin his battalion.

The requirements for a regimental aid station are the same as for battalions, with the following exceptions: More defilade is necessary for protection than at the shorter ranges, and roads to the front and rear are of greater importance. The distance of this station from the front lines is usually from 1,200 to 1,500 yards, depending on the formation.

A copy of the regimental and battalion field order is furnished the respective surgeons. If it is not furnished it should be requested, as the information contained therein is absolutely necessary in order that medical officers may act intelligently. The field order may be verbal, but no matter in which manner it is issued medical officers should know the (*a*) plan of attack, (*b*) the battalion and regimental boundaries, (*c*) the disposition of the troops, (*d*) the line of departure and (*e*) the first firing position.

2. The Medical Battalion

General.—The medical battalion is a tactical organization which renders technical service to an infantry brigade or reinforced infantry brigade. Upon the efficiency and teamwork of each of its component units and their cooperation with each other depends the rapidity of evacuation of battle casualties from battalion and regimental aid stations and their prompt treatment, resulting in a minimum number of sick days and the return of the man to the line. Conservation of man power is the mission of the medical department and this is one of the agencies through which this mission may be accomplished.

Organization.—The medical battalion consists of:

Nineteen officers, (18 M. C., U. S. N., 1 U. S. M. C.).

Three warrant officers, (2 H. C., U. S. N., 1 U. S. M. C.).

Two hundred and twenty-seven enlisted men, (152 H. C., U. S. N., 75 U. S. M. C.).

It is organized into a headquarters, and four companies—namely, a collecting company, an ambulance company, a hospital company, and a service company. (See T. of O. No. 18, U. S. M. C.) The battalion is commanded by an officer of the Medical Corps, United States Navy, usually a commander or lieutenant commander, who, in addition to commanding this unit, also serves in the capacity of brigade surgeon and serves on the administrative, technical, and supply staff of the brigade. As such he advises on technical matters relating to the medical department of the entire force.

Functions of the Battalion

Headquarters.—(*a*) Issues all orders pertaining to the internal administration of the battalion.

(*b*) Issues all orders pertaining to movement, disposition of its component units, and operation thereof on the march and in combat.

(*c*) Designates routes of evacuation.

(*d*) Maintains an office of record, keeps the war diary, and submits the records of casualties passing through its stations for the information of the brigade commander.

Collecting company.—(*a*) Establishes and operates the collecting station.

(*b*) Collects and transports casualties by litter from the battalion and regimental aid stations to the collecting station.

(*c*) Forwards supplies by litter bearers to the battalion and regimental aid stations.

(*d*) Establishes and maintains contact with battalion and regimental aid stations.

(*e*) Establishes march collecting stations.

(*f*) Furnishes sanitary squads for the supervision of sanitation.

(*g*) When necessary furnishes guards for the protection of medical department property.

Ambulance company.—(*a*) Transports the personnel of the collecting company to the site selected for its station.

(*b*) Evacuates casualties from collecting station to the hospital station.

(*c*) Whenever the situation permits, advances ambulances to the battalion and regimental aid stations and evacuates therefrom to the collecting station.

(*d*) In camp, makes scheduled trips to the various components of the brigade, collects the sick, and transports them to the hospital station.

(*e*) Ambulances are used to forward supplies from the medical distributing point to the forward stations.

(*f*) On the march ambulances are assigned for the transportation of march casualties.

Hospital company.—(*a*) In camp, establishes a hospital station for the care of the sick.

(*b*) In combat, establishes a hospital station for the temporary care of battle casualties.

Service company.—Transportation section: Furnishes chauffeurs for all motor vehicles and drivers for animal-drawn vehicles.

General supply section: (*a*) Furnishes clothing, food, and shelter for all members of the battalion.

(*b*) Furnishes food for all battle casualties passing through the stations operated by the battalion.

(*c*) Procures general supplies for the battalion from the brigade refilling point.

Medical supply section: Procures and issues medical supplies to the entire force.

Laboratory section: Furnishes laboratory service to the brigade.

Staff section: Furnishes personnel for the operation of battalion headquarters.

Principles of Operation

The principles of operation of the battalion do not differ materially from those applying to the medical regiment, United States Army, as laid down in the Army Bulletin, No. 13. These principles, with minor modifications, are as follows:

(*a*) The battalion commander is directly responsible to the brigade commander for the efficient operation of the medical battalion in all situations. Each subordinate commander in the battalion is responsible for the efficient performance of all duties assigned to his organization by proper authority.

(*b*) Commencing at battalion aid stations, there is, during and after combat, a constant sorting and classification of patients, which is completed, so far as the brigade medical service is concerned, at the hospital station. This is done primarily to expedite evacuation, to secure the early return to their own organization of those capable of performing duty, and to secure the best care and hospitalization of those requiring it. To this end:

(1) All cases who can perform duty and are not a menace to the health of the command are returned to their organizations.

(2) No cases are sent further to the rear than their own condition and the military situation demand.

(3) Cases which can be treated successfully in a command are not evacuated unless it is necessary to relieve the command of their care in order to free it for movement, or to make room for new cases.

(4) Serious cases are transported the shortest possible distance consistent with the military situation and their proper treatment.

(5) Cases requiring prolonged treatment are sent to the hospital ship for further transportation to the zone of the interior.

(*c*) The medical battalion is responsible for the evacuation of all casualties from the battalion and regimental aid stations, and from the field, when, for any reason, they can not be collected at the aid stations by the personnel operating these stations.

(*d*) Evacuations from the hospital station to the landing where casualties are transferred to boats will have to be performed by the ambulance company of the medical battalion. (This is one instance where the principle that units evacuate no further to the rear than their own station will have to be violated.)

(*e*) Hospitals are kept sufficiently clear of patients to permit the reception of new cases, and to leave them free for movement when required. During periods of activity patients are evacuated rapidly through the stations of the medical battalion to the hospital ship. During periods of inactivity the evacuations are less numerous and less rapid.

(*f*) In the execution of collection, evacuation, and hospitalization the demands of the military situation are paramount. The plans for the employment of the medical battalions are based in principle on the greatest good to the greatest number.

(*g*) Plans and orders for collection, evacuation, and hospitalization are made in conformity with and in amplification of combat plans and orders.

(*h*) Proper execution of evacuation and hospitalization requires that the medical battalion be informed of combat plans and orders in ample time for it to make its own plans and issue its own orders.

(For detailed organization of medical battalion see accompanying chart.)

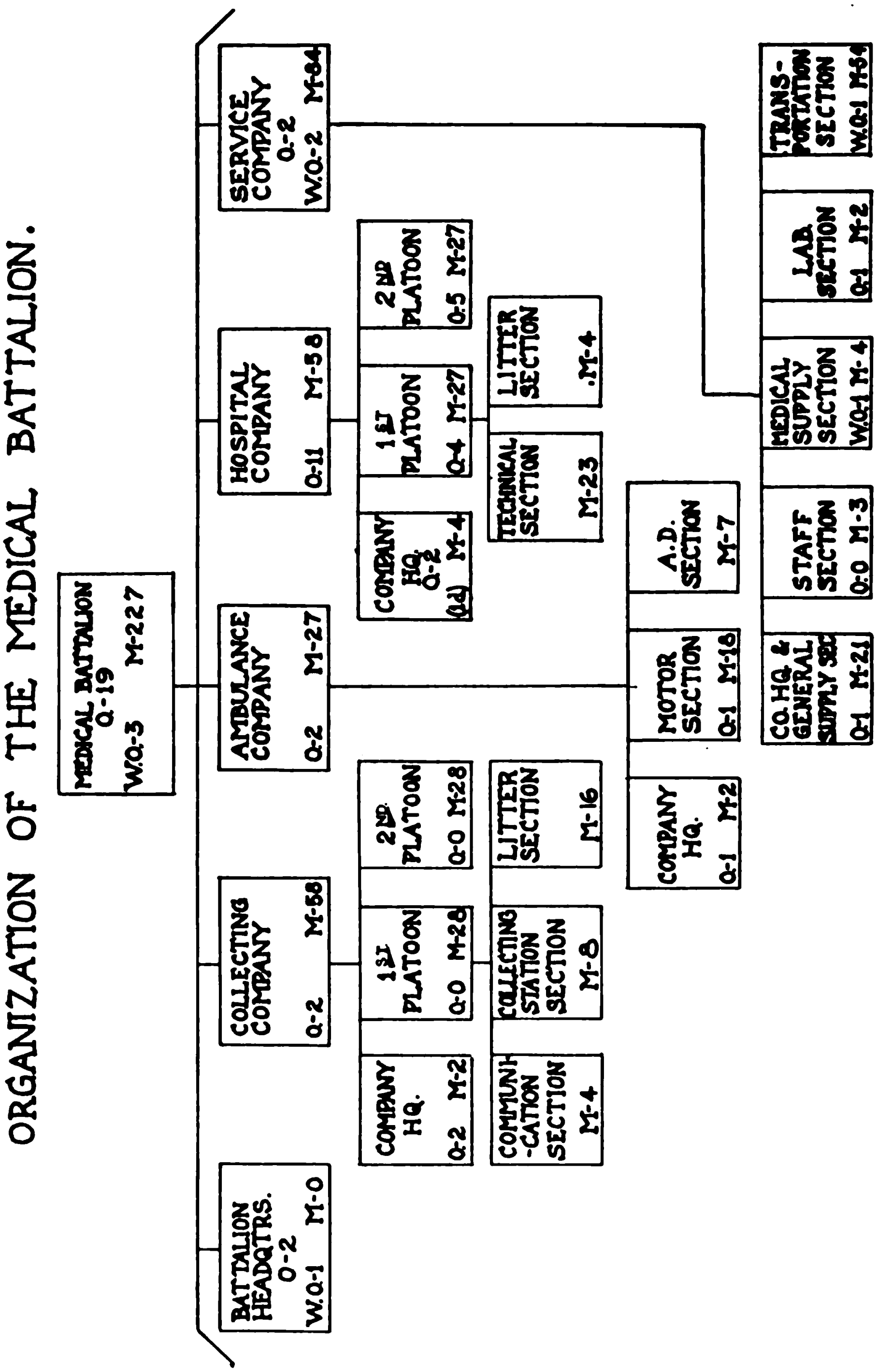


FIG. 19

4612—26——10

THE COLLECTING COMPANY

Organization.—The collecting company is composed of 2 officers and 58 enlisted men. It is organized into a headquarters and two platoons; each platoon is further divided for combat purposes into three sections; viz., a communication section, a collecting station section, and a litter section.

Function.—

In camp: The supervision of sanitation.

On the march: The collection and temporary care of march casualties.

In combat: The collection of casualties from the battalion and regimental aid stations and their transportation by litter to the collecting station where they receive primary care and are prepared for further transportation.

Operation.—

In camp: When so directed the company is divided into sanitary squads, each squad being assigned a limited area of the camp. They supervise general sanitation and sanitary devices under the direction of the medical inspector and submit all reports to him. These men do not perform any labor in connection with the construction of sanitary devices, latrines, etc., except in their own battalion area.

On the march: Whenever the situation does not permit the assignment of ambulances to battalions for the collection and transportation of march casualties, this function must be performed by the collecting company.

Before the day's march begins the commanding officer of the medical battalion selects sites usually about 3 miles apart along the route of the march where march collecting posts are to be established. The personnel consists of two men, in charge of a petty officer, for each station. These men are transported in ambulances to the sites, which should be located near a road junction connecting with a parallel road leading to the rear to facilitate the evacuation of serious cases. Ordinary march casualties are retained at the posts until the ambulance company, which marches at the head of the motor train, picks them up, and transports them to the next camp site.

The decision as to the number of posts to be established and the interval between them will depend on the following factors:

(*a*) The physical condition of the force.

(*b*) The state of training of the force.

(*c*) The weather.

(*d*) The roads.

(*e*) The terrain.

(*f*) Whether or not in the immediate presence of the enemy.

The individual equipment carried by each man, plus a few blankets and litters, is considered sufficient. No shelter is provided in the shape of tentage, but buildings should be utilized whenever possible.

In combat: As stated above, the mission of the collecting company in combat is the collection and transportation of wounded from battalion and regimental aid stations to the collecting station, and their primary treatment and preparation for further transportation to the rear.

The company is organized into two platoons in order to provide for a reserve if only one station is established, or that two stations may be established should this become necessary. In the small wars conducted by the Marine Corps one station is considered sufficient, the platoon in reserve to be used to "leapfrog" the station established should the combat troops advance rapidly or a pursuit be ordered.

In order that the personnel of the platoon going into action may arrive at the site selected for their station in the best possible physical condition, they are transported thereto in ambulances whenever this is feasible.

Action of the Platoon Commander: Upon receipt of the battalion field order the platoon commander should endeavor to make a personal reconnaissance of the terrain over which he is to operate. The field order will state that he will establish collecting station in the "vicinity" of a certain place. It is his duty to reconnoiter this vicinity and select the exact place where he is going to establish his station. He then returns to his platoon, leads it to the selected spot, and orders the station established.

The Communication Section: The members of this section are referred to as combat agents. Their function is to locate the battalion and regimental aid stations, obtain all the information possible from the surgeons in the forward areas as to number of casualties, types of wounds, and such further information of importance to the collecting station commander.

Upon arrival of the platoon at the site selected for the station the contact agents immediately move out to locate the forward stations, and having done so return as rapidly as possible with the information they have gathered, report what they have learned of the immediate situation, and then lead the litter bearer squads to the stations along routes they have selected. Contact agents are required to maintain contact with the forward stations and send back by litter bearers all information concerning the progress of the battle.

Contact agents should be intelligent men with a sense of responsibility. They should have a knowledge of map reading and be able to write a clear, concise field message.

The Collecting Station Section: Upon arrival at the site selected, this section, assisted by the litter-bearer section, proceeds to establish station. The station should be ready to receive wounded within 20 minutes after arrival. Shelter is provided in the form of a tent; a buiding should be used if one is available in the vicinity.

Collecting-station personnel should be trained in the treatment of shock, the administration of tetanus antitoxin and morphine, the application of splints and bandages as surgical assistants.

The Litter Section: Litter squads proceed to the forward stations guided by the contact agents and transport the wounded to the collecting station. The work is arduous, as roads are not always available. These men should have a knowledge of map reading; they must be taught how to advance under fire, inasmuch as their work lies in the zone covered by enemy artillery; and they must know how to take advantage of cover. Thorough training in first aid is essential for the members of this section.

Requirements of a station.—(*a*) Wood, water, and shelter.

(*b*) Near a good road leading to the rear.

(*c*) Average distance in rear of batallion aid stations, about 1,000 yards.

(*d*) Sufficient defilade to protect from normal overshots.

The Ambulance Company

Organization.—The ambulance company is composed of 2 officers and 27 enlisted men. It is organized into a company headquarters and two sections. The company operates 20 ambulances, 16 of which are motor, the remaining 4 being animal drawn. One officer commands the entire company, one the first or motor section, and a chief pharmacist's mate or pharmacist's mate, first class, commands the second or animal-drawn section. Chauffeurs and drivers are detailed for duty with this company from the transportation section of the service company. (The enlisted personnel of the ambulance company may be employed as litter bearers after a landing has been effected until such time as the ambulances can be placed ashore. In this event they are commanded by the junior officer in the company, the senior being employed in supervising the unloading of his equipment and getting it in shape for operation. When the hospital corps personnel is employed in this manner, they will evacuate casualties from the collecting station to the beach by means of the standard litter or wheeled litters if the latter are part of the equipment.)

Function.—

In camp: Ambulances designated for the day's duty make scheduled trips to the battalion and regimental dispensaries and trans-

port the sick to the hospital station. Except in cases of emergency no trips are made except those scheduled.

On the march: Normally all animal-drawn ambulances are assigned to combat battalions for the transportation of march casualties.

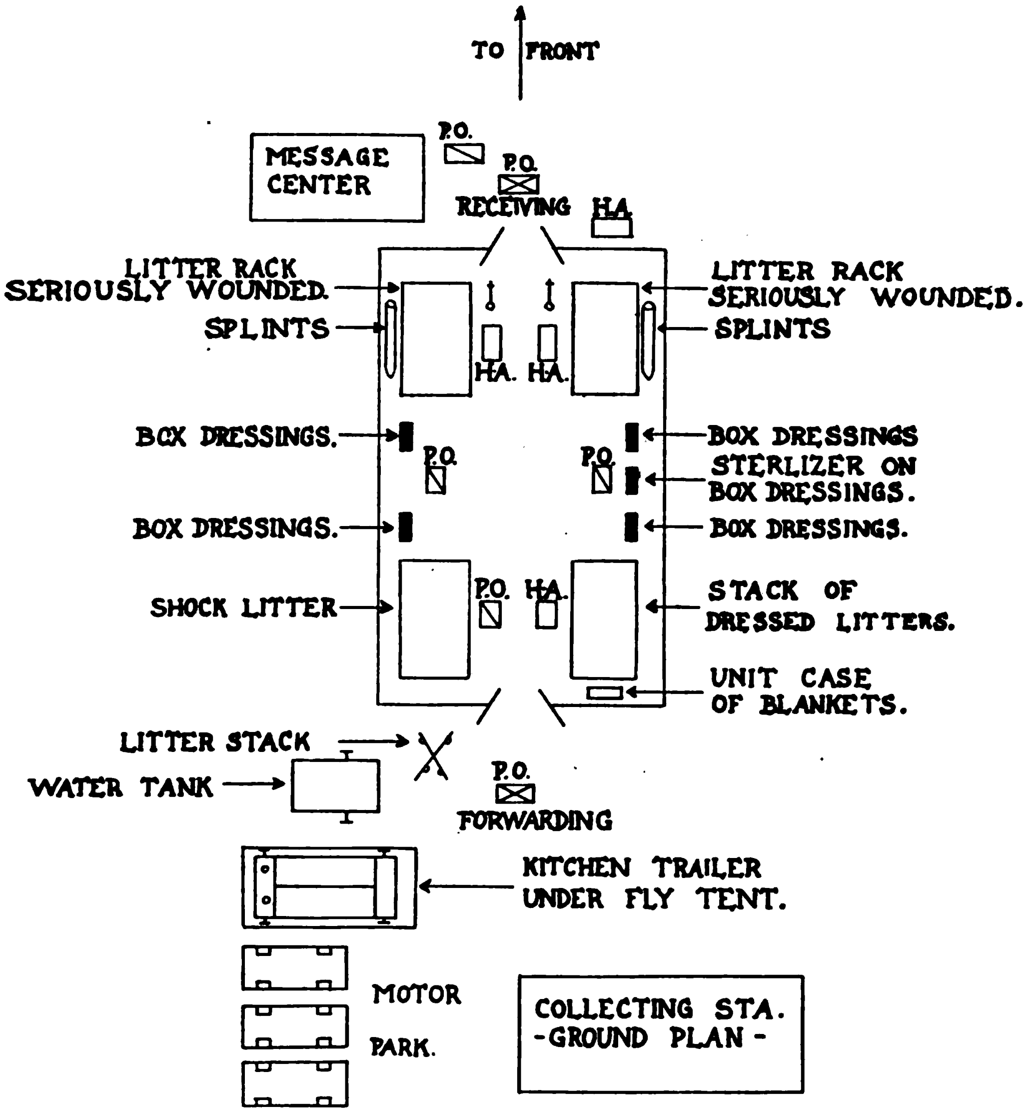


FIG. 20.—From Army Bulletin No. 13

In combat: The transportation of casualties from the collecting station to the hospital station (motor section). The transportation of casualties from the vicinity of battalion and regimental aid stations to the collecting station when the situation permits (animal-drawn section).

Operation.—

In camp: When so directed by the battalion commander the company commander prepares a schedule of ambulance trips to be made

during the succeeding 24 hours. He designates the number of ambulances to be employed. Ambulances take position in the vicinity of the hospital station and carry extra blankets and litters for exchange purposes.

On the march: The battalion march order will state the method of march casualty collection decided upon. If by ambulances, the company commander will detail one animal-drawn ambulance to each combat battalion for this duty. Upon the completion of the march these ambulances accompany the troops to which they are temporarily attached to their camp, where battalion surgeons examine the casualties. Those fit to resume the march the next day will be retained, those unfit are transported to the hospital station. Upon completion of this duty ambulances proceed to the ambulance park and report their return to company headquarters.

In combat: Upon receipt of the battalion combat order the company commander should make a personal reconnaissance of the roads leading to the front. He must find a suitable place for his headquarters from which to direct the operation of the company. This is usually about a mile behind the collecting station. The roads which are available for ambulances are usually designated in the combat order, this decision having been made at the conference held by the assistant chief of staff, B–4, which the brigade surgeon has attended. The company command post should be on the road over which ambulances pass on their way to the hospital station in order that the company commander may keep in touch with the situation through information received from ambulance personnel.

The Motor Section: Normally this section is employed in evacuating casualties from the collecting station to the hospital station. The number of ambulances so employed will depend on the situation and the number of casualties expected. To employ all ambulances unless the situation demands it is a tactical error; a sufficient number should always be held out as a reserve.

In addition to their function in connection with the evacuation of casualties, ambulances have another very important function, i. e., the forwarding of supplies to the advanced stations.

The Animal-drawn Section: Whenever the situation and terrain permits, this section is employed in transporting casualties from points in advance of the collecting station to the latter. These points are known as ambulance loading posts and at times, particularly at night, may be pushed as far forward as the battalion aid stations. This method materially relieves the litter bearers of long hauls which are not only hard on men and patients but are also time consuming.

The shuttle system (abstracted from the Army Bulletin, No. 13): This method of operating ambulances is undoubtedly the most satis-

factory. The system consists of one or more ambulance loading posts, one or more ambulance relay posts, and, when necessary, an ambulance traffic post.

Ambulance loading post is a point where one or more ambulances are located ready to receive patients for transportation.

Ambulance relay post is a point where one or more empty ambulances are located ready to move up to the next post to replace an ambulance that has gone to the rear.

Ambulance traffic post consists of a man located at a road junction or crossroads to direct ambulances to their proper destination.

Plate 1 illustrates this method between collecting station and hospital station.

Plate 2 illustrates the method in front of collecting station. (Fig. 21.)

These posts are selected by the company commander when he makes his reconnaissance. Distances between posts must be considered and also local cover.

The Hospital Company

Organization.—The hospital company consists of 11 officers, one of whom is a dental surgeon, and 58 enlisted men. It is divided into a headquarters and two platoons. The dental surgeon is attached to the headquarters of the company, but performs duty with the platoon at station.

Function.—

In camp: In the absence of a permanent hospital in the camp it establishes a hospital station for the care of the force sick. All cases requiring prolonged treatment are, however, evacuated to the base.

On the march: No function.

In combat: Provides temporary hospitalization for battle casualties of all types.

Operation.—

In camp: The company as a whole establishes station. If buildings are not available tentage is utilized. It is well not to erect more tents than necessary to care for the average daily increment of sick. In the absence of epidemics this will be less than 0.6 per cent of the force. In the absence of a permanent hospital in the camp the following tents must be erected: Company office, admission and dispensary; operating; X-ray; and a sufficient number of ward tents, medical and surgical. This group of tents is known as the "Basic Unit." Additional ward tents are erected when required.

On the march: The hospital company does not operate during the march. When not in the presence of the enemy the platoon in reserve may be sent to the next camp site, in advance of the troops,

to establish station for the reception of seriously ill or injured. In this event such casualties as may occur are evacuated forward. The old station disestablishes and goes into reserve for the day.

In combat: The location of the hospital station in combat will be designated in the battalion field order; the actual site is selected by

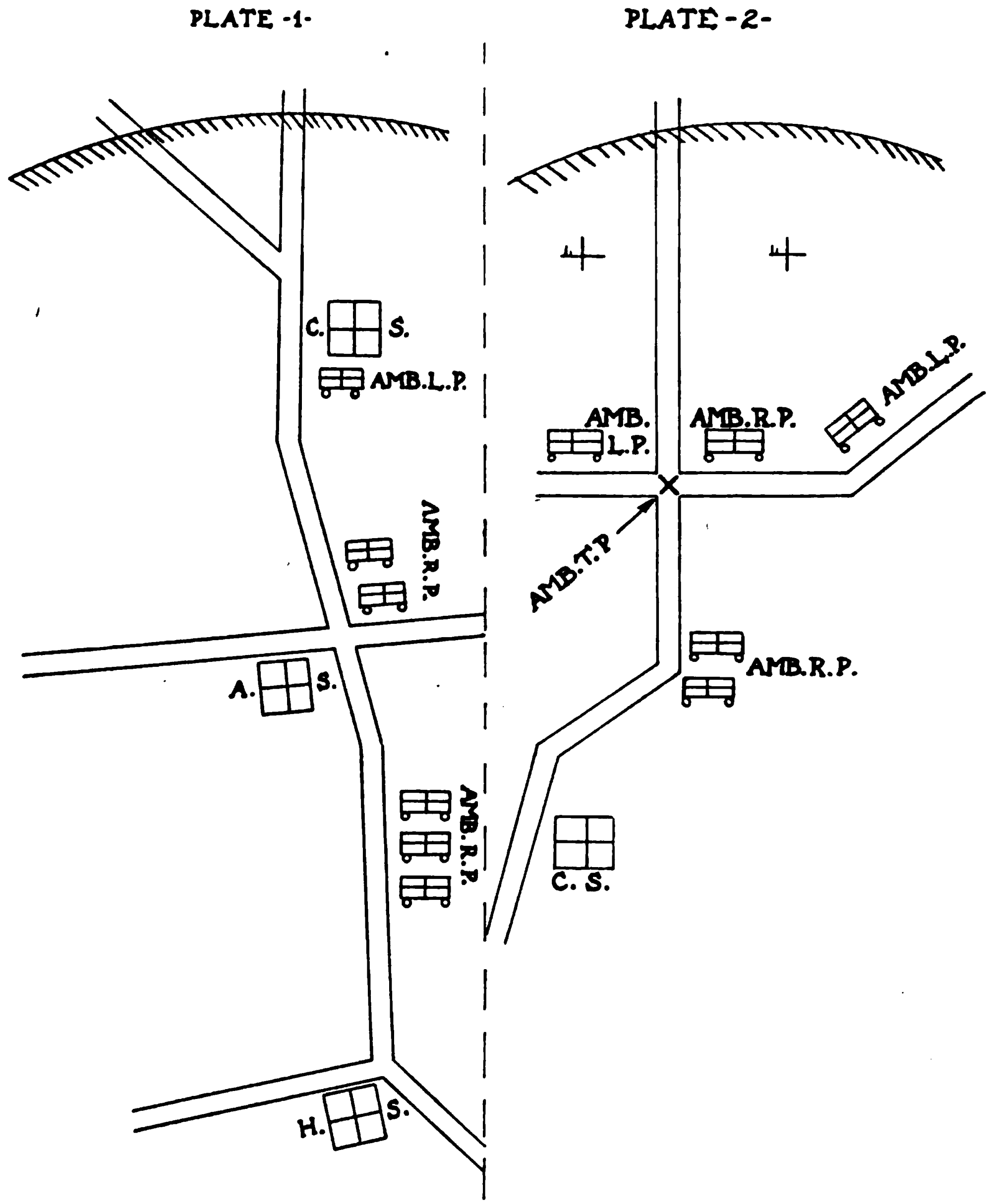


FIG. 21.—From Army Bulletin No. 13

the company commander after he has made his reconnaissance. The station is located from three to five miles from the front lines, just out of range of the enemy's light artillery. Whenever practicable it is desirable to locate it in a village or town in order that buildings may be utilized—a church, schoolhouse, local hospital, if one exists, or a public building. It should be on or near good roads leading to

the front, preferably close to a road junction connecting with a parallel road leading to the front. Wood and water are essential.

In open warfare situations the station is established by one platoon, one being held in reserve. After a successful attack, when the pursuit has been initiated, there are usually many wounded in the forward areas for whom there is no necessity for transportation to the rear. In such cases the platoon in reserve will be moved forward and will establish station, thus carrying the hospital to the wounded and avoiding long hauls. This is another principle of medical tactics. Every effort should be made to clear the first station established of its wounded by transferring them to the base, in order that the station may disestablish and go in reserve, or leap-frog and cover the troops in pursuit.

Inasmuch as the majority of patients admitted will be surgical cases, this department should be fully equipped. Provision must also be made for the comparatively few medical cases.

Toxic smoke and gas may be used in future wars; therefore, the hospital company must be prepared to treat these cases which will no doubt constitute the majority of the casualties. Both platoons will then have to establish station, one functioning as a surgical service, the other handling gas cases only.

The Service Company

The service company consists of 2 officers, 2 warrant officers, and 84 enlisted men. It is divided into five sections and is commanded by a captain, United States Marine Corps. Two of the sections, the company headquarters and general supply section and transportation section, are composed of Marine Corps personnel, whereas the staff, medical supply, and laboratory sections are composed of naval personnel. The company commander controls all sections from an administrative standpoint and the two composed of Marine Corps personnel in connection with their technical functions. The technical functions of the remaining three sections are controlled by the battalion commander.

Organization of section.—

Company Headquarters and General Supply Section.—One captain, U. S. M. C. (company commander and battalion Q. M.), 21 enlisted men, U. S. M. C.

Transportation Section.—One warrant officer (Marine gunner), U. S. M. C., 54 enlisted men, U. S. M. C.

The above two sections provide service for the battalion. General supplies are procured, stored, and distributed. Officers and enlisted men's messes are conducted, and chauffeurs and drivers are furnished for the motor and animal drawn vehicles of the battalion. The com-

pany administration is conducted in accordance with existing Marine Corps regulations.

Staff Section.—Three enlisted men, H. C., U. S. N.

This section furnishes personnel for battalion headquarters.

Laboratory Section.—One lieutenant, M. C., U. S. N., 2 enlisted men, H. C., U. S. N.

The personnel of this section not only furnishes clinical laboratory service to the hospital station but also performs such investigations as may be necessary in connection with sanitation.

Medical Supply Section.—One warrant officer, H. C., U. S. N., 4 enlisted men, H. C., U. S. N.

This section is of great importance. It is charged with the procurement and storage of medical supplies for the entire force. All stations, from the battalion aid stations to the hospital station, depended on this section for the replenishment of equipment. The chart (fig. 22), which is not drawn to scale, shows how supplies are procured and forwarded to the various medical department agencies.

Operation of the company.—Under all conditions the company establishes station in the vicinity of the hospital station. As far as general supply and messing of the troops is concerned no material difference exists between the operations of this company and any other service company while in camp. The transportation section furnishes personnel to operate such vehicles as are required to carry out the routine.

The laboratory section usually sets up its equipment at the hospital station and the medical supply section establishes a distributing point where medical supplies can be obtained on requisition by medical officers attached to combat units.

It is in combat that the resources and personnel of this company will be strained, particularly if troops are advancing rapidly and lines of communication become longer. In addition to cooking for the battalion personnel all casualties will have to be subsisted, at least temporarily. The personnel operating the collecting station several miles to the front require food, and this will either have to be forwarded in containers by ambulances returning to the front or a rolling kitchen detached for service at this advanced station.

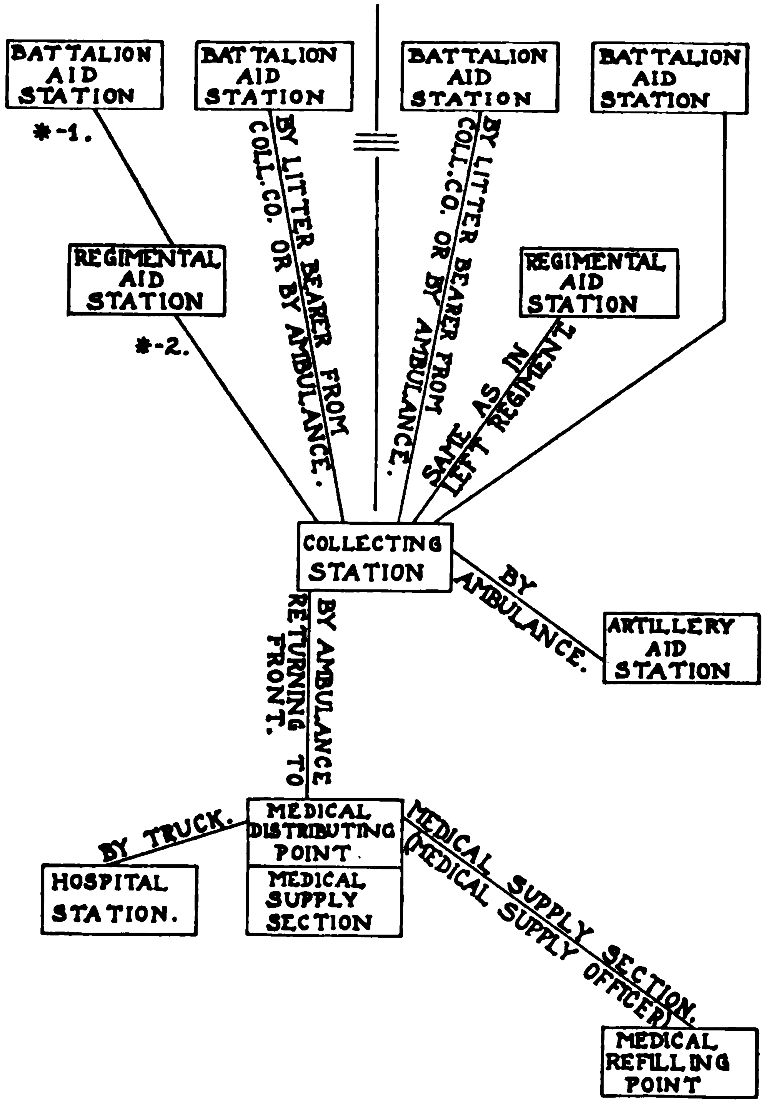
During an advance the laboratory personnel will not be required in connection with laboratory work and can be used to assist at the hospital station. The medical supply section establishes a distributing point and issues supplies on request to all medical personnel of the force. During and after battle such matériel must be forwarded to the front via ambulances and litter bearers.

Battalion surgeons draw on regimental surgeons or the collecting station for additional supplies and these are forwarded by litter

bearers or by such vehicles as may be operating in front of the collecting station.

The medical supply section can not carry more than a 24-hour supply and must in turn replenish its stores daily. Trucks must be sent

BRIGADE MEDICAL SUPPLY DURING COMBAT. CHANNELS AND AGENCIES OF SUPPLY.



*-1:-BY LITTER BEARER FROM REGIMENTAL AID STATION OR BY BEARERS FROM COLLECTING STATION.
*-2: BY LITTER BEARERS FROM COLL.CO. OR BY AMBULANCE, OCCASIONALLY BY MEDICAL COMBAT WAGONS FROM REGIMENTAL AID STATION.
NOTE :- LINES REPRESENT CHANNELS OF SUPPLY AND NOT ROADS.

FIG. 22

to the rear to the medical refilling point located at the base or at the rail head.

At all times there is a continuous exchange of litters, blankets, and splints. A litter squad bringing a casualty to the collecting station receives in exchange one litter, a splint, if one has been applied, and

the number of blankets used. The ambulance transporting this patient to the hospital station in turn receives one litter, one splint, and blankets from the latter.

(3) Supporting Medical and Hospital Facilities

The designation "base hospital"—for the want of a better term—is used in this connection to denote the fixed or semifixed hospital agency which furnishes "definitive" treatment to the sick and wounded. Those becoming sick or injured near the front lines are evacuated through the various medical establishments where they are constantly sorted—the more serious cases reaching eventually a fixed or semifixed hospital which cares for the case until well or else considered unfit for further service. This installation is the "base hospital" and gives "definitive" treatment.

The following represents in a general manner the respective functions of the various echelons of hospitalization employed. The functions are not sharply defined, as all medical stations sort patients to a limited extent. The evacuation hospital applies definitive treatment to certain cases.

Designation (suggested)	Function (primary)
Advanced hospital	Sorting—i. e., "Sorting" hospital.
Intermediate hospital	Evacuation—i. e., "Evacuation" hospital.
"Base" hospital. (The term "base is somewhat misleading if interpreted literally. The Army has substituted the term *general* hospital for *base* hospital.)	This designation applies to the principal hospital which administers definitive treatment, and is more or less immobile.

The hospital agencies which may be used as a base hospital for an expeditionary force consist of the following:

(*a*) Hospital station, established by the hospital company of the medical battalion.

(*b*) Station hospital.

(*c*) Navy base hospital

(*d*) Hospital ship.

The medical regiment, United States Army, was designed as a mobile tactical medical unit to serve a division. The medical battalion, United States Marine Corps, functions likewise with the brigade. In order that such formations may maintain a mobile status, the hospital company establishes a hospital station for only the temporary care of cases, and there must be a fixed, or semi-fixed, medical organization to receive such cases as will hinder movements of the hospital company when accompanying the division on the maneuver or in combat.

The above remarks apply particularly to the Army, and to the Marine Corps acting in a force larger than a brigade. There is reason to believe that a Marine Corps brigade—or a Marine force of similar or less strength—may be ordered to take the field at any time

under conditions where the opposition will be so weak, that the number of resulting battle casualties will not be sufficient to warrant the presence of a hospital ship or other hospital to act as a special unit for definitive treatment. Under such circumstances the hospital company of the medical battalion must establish a hospital for such type of treatment.

Consequently the medical battalion is supplied with sufficient equipment to enable part of the hospital company to establish and maintain a base hospital, while the other elements of the company can operate an advanced hospital, more mobile in nature.

As a general rule, it may be stated that this procedure is contrary to tactical principles, and hence should be limited in its use.

The organization, equipment, and tactical employment of the medical formations designated the "Station hospital" and the "Navy base hospital" have been discussed previously in Part II. These two units carry sufficient equipment to act as a base hospital to an expeditionary force.

The question has been continually arising relative to the precise value of a hospital ship as medical base to an expeditionary force. The majority seem inclined to favor its use, but on second thought their opinions do not seem to be so strong in this direction. One of the possible explanations of this is that it is an easy matter to say, "Send a hospital ship" and, presto, all plans for a medical base are completed. The prediction is ventured, however, that a force commander who has had experience with navy base hospitals and hospital ships acting as medical bases to his troops, would rather rely upon the assurance of the presence of a shore hospital than gain certain advantages which the hospital ship may possess, as the hospital ship may be on a forced absence at the critical moment when her services are most needed.

Some of the advantages and disadvantages of the shore and floating types of hospitals are tabulated below:

Hospital ship versus shore hospitals as a base for an expeditionary force

Hospital ship	Emergency shore hospital
Services immediately available upon arrival	Requires vessels to transport and time to establish (weeks or months).
Safe anchorage, and landing facilities demanded for evacuation of casualties from combat field.	Evacuation from expeditionary force can be rapid and prompt.
Expansion limited	Crisis expansion almost unlimited.
Satisfactory water supply	Water supply may be limited in quantity and of questionable quality.
Protection against mosquitoes and other disease-carrying insects.	Insect control more difficult.
Limited cubic air space for patients	Adequate cubic air space available by expansion.
In cold climates, heating facilitated	Cool in warm climates.
Component part of forces afloat and apt to be subjected to removal from local jurisdiction.	An integral component of the expeditionary force.
Permanently and semipermanently disabled soon clog the functions of the ship, unless transports are available to remove such.	Crisis expansion for accommodation of patients more readily arranged.
Subject to necessary periods of overhaul and to breakdown of motive power.	Maintenance relatively simple.
Uneconomical, as a ship is required in addition to hospital facilities.	When disembarked in theater of operation the transporting vessel is released for other activities.

Following is an account of the experiences of hospital ships operating as hospital supports to debarked troops:

We commenced work on the Beaches on June 29, 1915, and left the Gallipoli Peninsula with our last load of wounded for England on August 29. The routine for hospital ships working at the Front is as follows: all cases from the Beach come off to the hospital ship serving that Beach, are sorted on board, and the lighter cases (generally wounded who can walk) are sent to an advanced base by trawlers, usually stopping on board about 12 hours; this allows time to do their dressings, get them clean and fed before passing them on the advanced base. The more seriously wounded are retained on board the hospital ship, and this process of sorting is continued until all the available beds are occupied, when the ship is relieved by another and takes her load of wounded to one of the Mediterranean bases or home to England.

What we find does make a very great difference to our end results is the time that elapses between the infliction of the wound and its attention on board this ship. We have now had the opportunity of working more than once at each of the three Beaches from which wounded are brought off, and the difference in the condition of the patients from each Beach is most marked.

1. Helles Beach provides by far the most septic type of case. The average time between the men being wounded and received on board is from 22 to 24 hours, some being as long as three days. The reason for this apparently is that the front line trenches are farther from the Beach, and patients have to be brought back along the trenches and cross communicating trenches, owing to the hill and plateau being commanded by the enemy's fire. It is surprising the number of men from this Beach that are found to have defaecated in their trousers. When it is remembered that severe diarrhea is very prevalent and, as can be seen by a glance at the list of operations in this paper, that compound comminuted fractures of the thigh are also very prevalent, it is not difficult to imagine that one is fighting for good end results under very adverse conditions. The flies are also far more numerous on this Beach than on the other two; every patient is hoisted on board black with flies, and very soon after the first load or two has been received the decks and wards are also black with flies. Many wounds are found on arrival to be already swarming with maggots. Also this is the only Beach from which we got cases of gas gangrene.

2. Anzac Beach is by far the best from our point of view, the front line of trenches being only a short distance from the sea, the average time taken to put men on board after they have been wounded being five to six hours. There are fewer flies, and the Australians and New Zealanders who occupy this Beach are very fine men physically. The results obtained from exactly similar wounds under exactly similar treatment are far better in cases from this Beach than from the other two.

3. Suvla Beach comes between Helles and Anzac as to the septicity of the cases. The average time taken to put a wounded man on board the ship after being wounded is between nine and ten hours. We have had no gas gangrene cases from this Beach, but we have had wounds with maggots already crawling about them.

It will be seen from the above description of the three Beaches that results depend much more on what Beach is worked than on what particular antiseptics are favored, or, in other words, on how soon we get our patient after he is wounded. (Dalton, F. J. A.: Jour. Roy. Nav. Med. Serv., II: 1. (Jan.) 1916.)

In addition to supporting hospital agencies, a medical supply depot *must* be established in the rear of the expeditionary force. This depot becomes the medical refilling point for the force from which the medical supply section of the service company replenishes its stores and reissues to the *force* which it serves. The transportation of this section is limited and a 24-hour reserve only can be carried in order to preserve its mobility. In combat daily replenishment will be necessary.

As the United States Navy has adopted no standard organization for this type of medical unit, the following composition of a "Medical Supply Depot, U. S. Navy," designed for medical supply of a force of 5,000 to 10,000 men is suggested:

Lieutenant, Medical Corps	1
Chief pharmacist	1
Chief pharmacist's mate	1
Pharmacist's mates, first class and second class	3
Lower ratings	6

(To be concluded in the January number)

USEFUL HEPATIC FUNCTION TESTS

By W. W. Hall, Lieutenant, Medical Corps, United States Navy

The study of liver function is a live subject. Much valuable and interesting work on the liver has been done by a number of workers in recent years, both in the field of physiology and of clinical pathology. Recent advances in physiology and biochemistry, largely made possible by the development of rapid and accurate methods in blood analysis, are responsible for the progress in our knowledge of liver physiology and pathology.

Investigations of liver activities are beset with many difficulties. In the case of the kidney the raw material (blood) and the finished product (urine) were both easily obtained for analysis. The liver, on the other hand, receives its raw material (blood) through the portal circulation and delivers it into the hepatic vein while the bile may be obtained only from the duodenum more or less mixed with its other contents. Thus, new methods of study were necessarily developed by investigators of liver physiology and pathology.

The present status of our knowledge of the physiologic functions of the liver may be outlined as follows:

Carbohydrate metabolism.—It has long been known that, through its storage of glycogen, the liver is the great carbohydrate reservoir of the body. Mann (2) has shown that following total removal of the liver the blood sugar level fell steadily until the same group of symptoms developed which follow insulin hypoglycemia. He re-

stored the blood sugar to normal level and maintained the animal in apparently normal condition by glucose injections repeated at intervals. In this condition he maintained the animal for sufficient time for further study.

Removal of the pancreas in addition to the liver merely speeded the hypoglycemic reaction and rendered the glucose injections less effective. Attempts have been made to measure the glycogenic function of the liver clinically by means of its ability to store fructose, but, although they "may be valuable from an experimental standpoint, they are of questionable importance in the diagnosis and treatment of the individual patient." (Greene) (3).

Bile pigment formation and excretion.—Mann (2) has proved conclusively that bilirubin accumulates in the blood after removal of the liver and that removal of both the spleen and liver does not alter the accumulation of this pigment. The conclusion must be that the liver acts, with reference to bile pigment, principally as an excretory organ and that some other organ or system of cells is responsible for the formation of this pigment from hemoglobin. Definite information has not as yet been obtained concerning cholesterol and bile salts, although some evidence seems to point to an accumulation of bile salts in the blood after removal of the liver.

Nitrogen metabolism.—The liver has been considered as the organ in which the majority of the deaminization of amino acids and synthesis of urea is carried on. In fact, the significance of the occurrence of leucin and tyrosin crystals in the urine of patients with acute yellow atrophy lies in the loss of this function by the liver. It has also been thought that all other cells of the body may exercise the deaminizing functions to a limited degree as necessary. Mann's experiments prove definitely that formation of urea stops absolutely upon hepatectomy and, at the same time, the amino acid content of the blood and urine increases. If the animal becomes anuric the amino acids of the blood increase very markedly. Mann also found that uric acid accumulates rapidly following removal of the liver and that vast amounts of urates are excreted in the urine. The liver, therefore, seems to play some rôle in the metabolism of purines.

The liver, however, apparently has so large a safety factor that comparable results do not occur clinically even in cases of gross liver damage.

Detoxication.—The liver plays a large part in the body's remarkable ability to detoxify poisonous substances introduced by various avenues. Widal has suggested that the liver detoxifies protein cleavage products which come to it in the portal circulation during digestion. When this "proteopexic" activity is interfered with these toxic products produce a leukopenia or "hemoclastic crisis." This

has been used as a test of liver function or of liver damage by Widal, "but its diagnostic value has not yet been established." Greene (3).

Blood coagulation.—The liver probably also produces fibrinogen (particularly after hemorrhage), and the delay in coagulation of the blood in cases of icterus and liver damage is as well known as is the leukopenia of icterus.

Iron, particulate matter, and bacteria.—The liver has been shown to receive and store iron-bearing pigment (siderosis) (7). The liver is essential in the removal from the blood stream of particulate matter and foreign material in colloidal suspension. The liver also removes bacteria from the blood stream and thus helps to prevent organisms which have penetrated the intestine from entering the general circulation.

Dye excretion.—Numerous dye substances have been found to be excreted either wholly or in part by the liver. Of these may be mentioned mercurochrome 220, rose bengal, phenoltetrachlorphthalein, and bromsulphalein, and other phthalein compounds. Phenoltetrachlorphthalein was first introduced by Rowntree and Rosenthal and has been studied rather extensively, but is being abandoned in favor of bromsulphalein, brought out by Rosenthal (9), because of the safety, ease, and convenience in dosage of the latter.

The liver then appears to function as an organ which—

1. Stores carbohydrates as glycogen.
2. Helps to maintain the blood sugar level.
3. Excretes bile pigment.
4. Excretes cholesterol (synthesis in question) and bile salts.
5. Is the important seat of intermediary nitrogen metabolism (amino acids deaminized, urea synthesized, purins changed).
6. Detoxifies many substances.
7. Helps to remove particulate matter and bacteria from the blood.
8. Aids in the coagulation of blood by production of fibrinogen.
9. Excretes a number of foreign compounds, such as the dyes, in the bile.

With this multiplicity of function it is obviously impossible to obtain a single test that will cover all. As it is very probable that the different functions are variously affected in different cases of liver damage or malfunction, the result of an individual test must be interpreted with care. Relative simplicity in technique and accuracy in the estimation of a specific liver function which gives data of clinical value are points which an accepted functional test should possess.

We have used—

1. The Icterus Index (11), because it offered an extremely simple colorimetric method of estimating the icteric tint of serum.

2. The Van den Bergh (4), because it offered a quantitative estimation of bilirubin in the serum and a differentiation of bilirubin of hemolytic from that of obstructive origin.

3. The Bromsulphalein Hepatic Function Test (9), because it offered a simple and accurate method of estimating the liver function as measured by the excretion of that class of substances.

Icterus Index

Meulengracht method (modified) as given by Bernheim (11). Draw 10 c. c. blood by venipuncture into a centrifuge tube and allow to clot. Separate serum by centrifuge and pipette off. Compare in a colorimeter with an arbitrary standard—1–10,000 potassium dichromate ($K_2Cr_2O_7$) (0.050 gm. to 500 c. c. dist. water). The unknown (serum) is read in a colorimeter against the standard set at 15. Divide the reading at which the unknown matches the standard into the reading of the standard. This quotient multiplied by the dilution of the unknown (necessary when serum is deeply colored) equals the index.

$$\frac{\text{Standard}}{\text{Unknown}} \times \text{Dilution} = \text{index}.$$

When dilution is necessary use 0.9 per cent sodium chloride. The normal range was found by Bernheim to be 4 to 6, latent jaundice 7 to 16, and clinical jaundice from 17 up.

As stated by Ravdin (5) other pigments such as carotin may color the serum and the slight hemolysis, which often occurs before the serum is separated from the clot, makes comparison difficult, and to the degree that the misleading color is present, inaccurate. This is especially noticeable in the lower ranges of color (normals, latent, and early clinical icterus) where accuracy means much.

Van den Bergh Reaction

Van den Bergh developed his reaction by applying the Ehrlich diazo reaction to sera containing bilirubin. The reaction depends upon the development of azobilirubin, a red azo dye, when an acid solution of a diazonium salt is added to a solution containing bilirubin. Van den Bergh determined that pure bilirubin in a dilution of 0.7 mg. per liter gave a positive reaction and that biliverdin and other substances in the serum did not.

Two types of jaundice are differentiated by the Van den Bergh test and their differentiation depends upon the fact that bilirubin in one type (obstructive) combines directly with the diazo reagent to form an azo dye, azobilirubin, while the bilirubin in the other (hemolytic) type seems to be bound in such a way that it requires the addition of alcohol to the serum before the formation of azo-

bilirubin can occur. The two classes of jaundice represent general groups with distinctly different location and type of pathological lesion. A brief review of the theory of bilirubin formation and excretion may be of help in understanding Van den Bergh's classification.

Erythrocytes are constantly being destroyed in the body and the liberated hemoglobin gives rise to bilirubin through the action of the cells of the reticuloendothelial system. These cells are found throughout the body in the endothelium of vessels and capillaries but most abundantly in the sinusoids of the spleen, lymph glands, and liver. The bilirubin thus formed is presumed to be present in "combination" in the blood stream. As the blood passes through the liver the parenchymatous or polygonal cells extract the bilirubin and excrete it into the bile canaliculi. When for any reason the flow of bile is obstructed this pigment passes again into the blood by absorption but continues to react as does the pigment in the bile itself, the action of the polygonal cells apparently having permanently changed it in some way. That pigment, present in small but constant quantity normally, and in much larger amounts in conditions characterized by increased destruction of red cells or liver damage, reacts only in the presence of alcohol which is thought to split it from its protein complex. Van den Bergh calls the former type of pigment "obstructive" and the jaundice in those conditions "mechanical," while the jaundice of hemolysis he calls "dynamic." S. M. Rosenthal (6), speaking at the Atlantic City A. M. A. convention, said "In an attempt to find out the mechanism by which certain dyestuffs and bilirubin are excreted by the liver, I have studied their behavior from a physicochemical standpoint. By ultra filtration experiments I have found that they circulate in the blood firmly bound to the serum proteins. This prevents their elimination by the kidneys. Bile salts by their effect on surface tension are able to liberate bilirubin and these dyestuffs from their adsorption compound with the proteins so that they can be further excreted by the liver."

Technique of the method.[1]—Draw 5 c. c. of blood by venipuncture into a dry centrifuge tube and allow to clot. Separate serum, by centrifuge if necessary, and pipette off. The diazo reagent which must be made up just before use is a mixture of two solutions:

Section A—

Sulphanilic acid	1.0 gm.
Conc. HCl	15.0 c. c.
Water (dist.) qs	1,000.0 c. c.

[1] Reagents must be of best quality. Sulphanilic acid must be reasonably fresh. Very old samples have failed to react well.

Section B—

Sodium nitrite	0.5 gm.
Water (dist.)	100.0 c. c.

To prepare fresh reagent—

Solution A	25.0 c. c.
Solution B	0.75 c. c.

The qualitative or direct reaction.[2]—Place 0.25 c. c. serum in each of three small test tubes. To tube No. 1 add 0.2 c. c. water. To tube No. 3, 0.2 c. c. diazo reagent (fresh). After waiting five minutes for reaction to become complete in control tube No. 3, add 0.2 c. c. diazo reagent to tube No. 2. Watch and time development of any reaction. Prompt or immediate reaction begins before 30 seconds have elapsed. Comparison with serum control, tube No. 1, and completed reaction control, tube No. 3, will aid in detection of color.

The quantitative test or indirect reaction.—To 1 c. c. serum in a 15 c. c. graduated centrifuge tube add 0.5 c. c. diazo reagent (freshly prepared as above). After a minute or two add 2.5 c. c. 95 per cent alcohol and 1.0 c. c. saturated solution of ammonium sulphate $(NH_4)_2SO_4$. Mix well with a stirring rod after each addition and finally centrifuge.

The diazo reagent is added before the alcohol to allow "coupling" (4) to take place. By this method very little, if any, bilirubin is carried down with the precipitated protein, as the azobilirubin is very soluble in alcohol, while bilirubin is less so and is carried down with the precipitate in relatively large amount if the reagents are added in the reverse order. The color of the supernatant fluid will vary from a faint pink, as in normal serum, to a deep violet, depending on the amount of bilirubin present.[3] The quantity of supernatant fluid is read on the graduations of the centrifuge tube and the dilution of the bilirubin contained in the cubic centimeter of serum used is thus directly obtained. The quantity of bilirubin present in the serum (1 c. c.) is now, as azobilirubin, entirely in alcoholic solution. This supernatant alcohol usually varies from 2.5 to 3.0 c. c. The calculation of the dilution (1 in 4), as used by Ravdin (5), does not appear to be accurate. We have had no difficulty in reading the amount of supernatant alcoholic solution, as the ammonium sulphate, protein, and alcohol layers separate very sharply on centrifuging. (Fig. 1.) As the color of the standard represents a bilirubin concentration of 5 mg. per liter the calculation is:

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[2] From note on improvement in technique (4). We have, however, discarded the use of caffiene sodium salicylate, for we have found that its effect was very inconstant, as did McNee and Keefer (4).

[3] Chylous sera give cloudy solutions, which are objectionable for colorimetric comparisons.

$$\frac{\text{Standard}}{\text{Unknown}} \times \left\{ \begin{array}{l} \text{Dilution of unknown[4]} \times 5 = \text{mg. bilirubin per liter of} \\ \quad \text{serum (using a plunger type of colorimeter).} \end{array} \right.$$

or,

$$\frac{\text{Unknown}}{\text{Standard}} \times \left\{ \begin{array}{l} \text{Dilution of unknown[4]} \times 5 = \text{mg. bilirubin per liter of} \\ \quad \text{serum (using a dilution type of colorimeter).} \end{array} \right.$$

Standard for the quantitative reaction:

Solution 1—	
Ammonium ferric alum	0.1508 gm.
Conc. HCl	50.0 c. c.
Water (dist.) qs	100.0 c. c.
(Keeps indefinitely.)	
Solution 2—	
Of solutions 1	10.0 c. c.
Conc. HCl	25.0 c. c.
Water (dist.) qs	250.0 c. c.
(Keeps about one month.)	
Standard which is made fresh daily—	
Of solution 2	3.0 c. c.
10 per cent ammonium sulphocyanate or 20 per cent potassium sulphocyanate	3.0 c. c.
Ether	12.0 c. c.

Shake thoroughly. The ether extracts the color from the solution and forms a supernatant layer which may be used in colorimetric comparison. The standard matches in color a dilution of 5 mg. per liter of bilirubin.

By the use of cobaltous sulphate as suggested by Van den Bergh and first published by McNee and Keefer (4) a permanent aqueous standard may be made which avoids many of the errors and difficulties inherent in the ether standard. They advise the use of 2.161 gm. anhydrous cobaltous sulphate to 100 c. c. water. This standard also represents the color given by 5 mg. bilirubin per liter. We, however, found it impossible to obtain or make anhydrous ($CoSO_4$) cobalt sulphate, as decomposition took place while the water of crystallization was being driven off. It was also impossible to obtain an accurate weight using the crystalline salt, allowing for the seven molecules of water of crystallization ($CoSO_4.7H_2O$), as the salt is somewhat efflorescent and perfect crystals almost never are found. We therefore suggest that the cobalt sulphate standard be made up as follows: Make an aqueous solution somewhat deeper in color than the ether standard, compare in colorimeter, and dilute as indicated to match the color in the ether standard. This solution keeps well in the dark. We have found that the addition of 0.5 c. c. H_2SO_4 per 100 c. c. does not change the color and the solution keeps thus indefinitely.

[4] As read from the supernatant alcoholic solution in graduated centrifuge tube. (Fig. 1.)

Interpretation: The normal range of bilirubin is from 1 to 3 mg. per liter, latent jaundice from 4 to 20, and clinical icterus from 20 up. If reported in units, one unit equals 5 mg. bilirubin per liter.

There are three possible results in the direct reaction:

Immediate or prompt.—Beginning before 30 seconds have elapsed and reaching its maximum in about two minutes.

Delayed.—Beginning after 30 seconds. These reactions develop slowly. The longest in our experience has been 30 minutes, although McNee and Keefer (4) report delayed reactions which took one hour to develop.

Negative.—No color developed in 30 minutes.

The prompt direct reaction is given by the bilirubin in the obstructive type of jaundice. Delayed or negative reactions may be obtained in both normal sera and those from cases of nonobstructive or hemolytic jaundice. We have dropped the term "biphasic" reaction which was used to describe a reaction beginning promptly and not reaching its maximum until after 30 seconds since we found, as did Andrews (13), that no specimens, no matter how intense a prompt direct reaction they gave, developed their maximum color before one to two minutes had elapsed. We have, therefore, classed as "prompt direct" any reaction beginning before 30 seconds. The delayed and negative direct reactions may be grouped together as both may be obtained in normals and in nonobstructive jaundice.

The indirect reaction serves both to measure the bilirubin and to develop a color with bilirubin in the presence of alcohol which gave none in the direct reaction. Thus it demonstrates and measures the jaundice of hemolytic origin and brings to light a jaundice of latent type; that is, one in which the concentration of bilirubin has not reached the level at which it can be demonstrated in the urine by the usual tests nor can be detected clinically in the sclera and skin. We have found no case in which color was entirely absent in the quantitative or indirect reaction, although many, in fact, most normals, gave a reading of less than 1 mg. per liter (0.2 unit).

We do not agree with McNee and Keefer (4) that the reactions change on standing and that specimens which originally gave a prompt direct reaction give a long delayed reaction later. We have kept sera as long as three months and at the end of that time they still gave a prompt direct reaction as before. Slight hemolysis has not interfered with the reactions.

Bromsulphalein Test for Hepatic Function

The use of this compound introduced by Rosenthal (9) has given us a dye test for liver function which may apparently be used without the least fear of untoward reaction. Bromsulphalein (phenoltetrabromphthalein sodium sulphonate) need only be given in doses

of 2 mg. per kilogram body weight while phenoltetrachlorphthalein as first used by Rosenthal and Rowntree was given in doses of 5 mg. per kilogram body weight necessitating inconveniently large doses of the 5 per cent solution. Occasional unpleasant reactions were also reported which has not been the case with the use of bromsulphalein.

The technique as given by Rosenthal (9) is as follows:

Weigh patient and calculate dosage on basis of 2 mg. bromsulphalein per kilogram body weight. Weight in pounds divided by 55 gives the exact quantity in cubic centimeters of the 5 per cent solution to be injected. Measure bromsulphalein by aspirating sterile solution from ampule[5] into a sterile 5 c. c. syringe. Inject slowly into an arm vein. Injection should take at least one minute. Avoid infiltration of dye outside vein. Thirty minutes after injection draw 5 c. c. blood by venipuncture from opposite arm. Place in a dry centrifuge tube. In cases of early liver disease it may be advisable to obtain also a sample at exactly five minutes after injection.

Separate serum and pipette into two small test tubes. Add to one, 1 or 2 drops sodium hydroxide, 10 per cent solution, to bring out the color of the dye, and to the other add a drop of 5 per cent hydrochloric acid, to clear the serum of any hemolysis. Estimate the amount of dye present by direct comparison with a series of standards. Place the tube of clear acidified serum in front of the standard and back the alkalized tube of serum by a similar tube containing water, in a suitable comparator box.

Preparation of standards.—Add 4 mg. of bromsulphalein to 100 c. c. distilled water alkalized with 0.25 c. c. sodium hydroxide, 10 per cent. This is the 100 per cent standard. By proper dilutions with similarly alkalized water prepare 10 standards ranging from 10 to 100 per cent. Seal in small test tubes. No deterioration occurs for several months if stored in the dark when not in use.

Normals are as follows (9): Five minutes after injection from 20 to 50 per cent of the dye is present in the serum, with an average of 35 per cent. In 30 minutes after injection the dye is entirely gone or only a faint trace is present, too small to estimate. The amount of dye remaining in the serum at the end of 30 minutes may thus be taken as the numerical measure of the lost hepatic function. In normal cases the dye appears in the urine in negligible quantities ranging from none at all to 0.5 per cent of the amount injected. We have noted that, as Rosenthal (9) says, the dye excreted in the urine when the dye is retained by the liver bears no quantitative rela-

[5] Ampules of sterile 5 per cent solution bromsulphalein may be obtained from Hynson, Westcott & Dunning, Baltimore.

tion to the amount in the blood, and fluctuates markedly following injection (as in case No. 3). Still, in gross loss of liver excretory function large quantities of dye appear in the urine and it is probably entirely excreted in the urine, while minor loss of dye excretory function by the liver is accompanied by only slight amounts of dye excreted in the urine. Thus the *total* amount excreted in the urine *does* bear a definite relation to the amount in the blood, although the amount excreted hour by hour may not.

In the following cases one or more of the above tests have been employed and in the cases of acute cholangitis all three are charted to show the relationship in results obtained:

Case 1

Patient felt a dull pain under right costal margin for about a week prior to admission. Icterus first noted one day prior to admission (February 15). Icterus as judged by bilirubin estimation reached its peak on the 20th of February. On the 23d the Van den Bergh had droped to 60. This fall continued until about the 3d of March, when the bilirubin concentration of the serum remained relatively constant for a week or more. After this date (March 10) an earlier gradual fall of bilirubin probably could have been shown had repeated examinations been made. This lag period between March 3 and 10—in which the serum bilirubin remained constant—probably represents the period of desaturation of the tissues in which the rate of bilirubin excretion about equaled the rate at which the tissues gave the pigment up to the blood. It will be noted that the bilirubin concentration from the 1st of March on was below that of clinical jaundice and within the latent jaundice portion of the scale (3 to 20), showing a higher concentration in the tissues in the period of decline of icterus than in the blood. The reverse could probably be demonstrated were it possible to follow a case of acute cholangitis from the beginning of the illness to the peak of the jaundice. That is, the concentration in the blood would ascend more rapidly than the tissues could take it up, and thus, without clinical icterus, be far into a concentration which would have shown clinical jaundice had the increase been slower and an opportunity for equalization between blood and tissues been given.

Bromsulphalein excretion reached normal sometime between the 25th of February and March 3 as the excretion was a trace estimated as 2 per cent on the latter date. Bromsulphalein excretion may be expected to return to normal earlier than the bilirubin due to the lag period of tissue desaturation as mentioned above.

The total amount of dye excreted in the urine seems to follow roughly the retention by the liver although, as noted elsewhere, no parallelism between the concentration in the blood and the percentage excreted in hourly specimens can be demonstrated. Bile was noted in the urine until the 1st of March when a faint trace was recorded corresponding to a serum bilirubin concentration of 20. Thereafter the urine was negative for bile.

The qualitative Van den Bergh gave an immediate direct reaction throughout (bilirubin of obstructive origin) until it became negative, even though the concentration was lower in four instances than in case 4, which was clinically

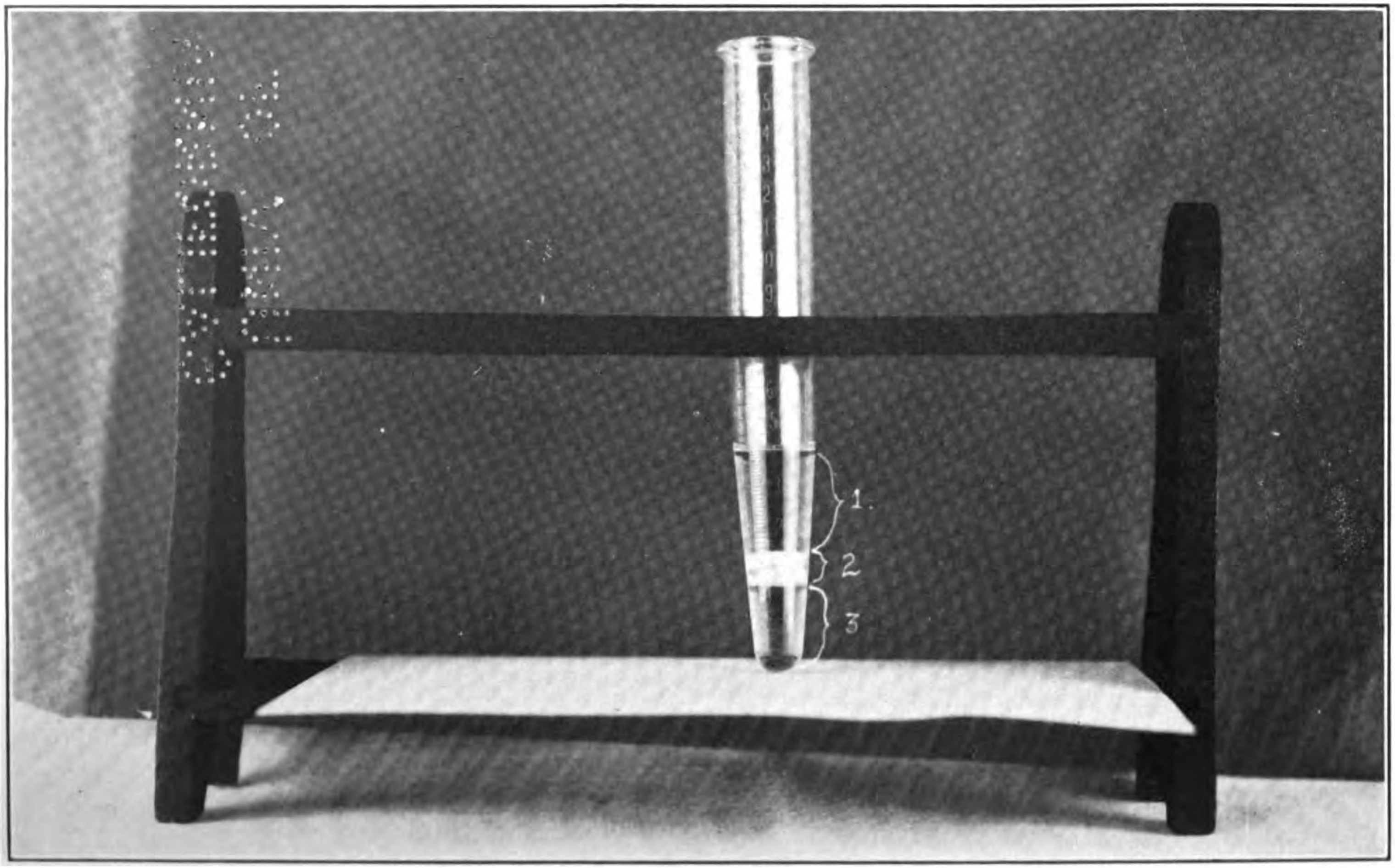

FIG. 1.—QUANTITATIVE VAN DEN BERGH REACTION COMPLETED

Note sharply separated layers. (1) Supernatant alcoholic layer containing in solution as azobilirubin all the bilirubin present in the serum added (1 c. c.) (2) Layer of precipitated proteins. (3) Ammonium sulphate layer

not of the obstructive type and consequently gave a long delayed reaction. The chart shows the tendency evident in acute conditions for all tests to give corresponding results and to vary together.

Case 1

Cholangitis acute. C. M. K., A. M. M. 1c.

Date	Van den Bergh		Icterus Index	Bromsulphalein dye retention	Urine	Miscellaneous
	Qualitative	Quantitative				
Feb. 17, 1926	I. D.	85			Bile 4+	WBC. 4, 700, P-69, L-42, LM & T-2, E-2, B-1.
Feb. 19, 1926	I. D.	100	116		Bile 4+	
Feb. 20, 1926	I. D.	107	105	30-minute specimen, 75 per cent; 90-minute specimen, 70 per cent.	Bile 4+30-minute specimen after dye injection, showed over 200 per cent.[1]	Sclera and skin deeply colored.
Feb. 23, 1926	I. D.	60	91		Bile 4+	
Feb. 25, 1926	I. D.	40	68	30-minute specimen, 20 per cent.	Bile 4−dye−30-minute specimen, 90 per cent.	Bile in stool.
Feb. 27, 1926	I. D.	40	47		Bile 4+	Sclera began to clear up.
Mar. 1, 1926	I. D.	20	29		Bile—faint	
Mar. 3, 1926	I. D.	10	34	30-minute specimen, 2 per cent.	Bile—negative 30-minute specimen, no dye.	Sclera still moderately yellow.
Mar. 5, 1926	I. D.	8.5	40		Bile—negative	Sclera still slightly yellow.
Mar. 10, 1926	I. D.	8.5	33	30-minute specimen, negative.		
Mar. 21, 1926	N. D.	1	25		Bile—negative	Sclera clear.

[1] Matched with blood standard.

Rosenbach-Gmelin test used for bile in urine.
I. B.—Immediate direct reaction.
N. D.—Negative direct reaction.
Van den Bergh quantitative—reported in mg. bilirubin per liter serum.

Case 2

Illness began three weeks before admission to the hospital. Had been intensely jaundiced for about a week prior to admission. During his stay in the hospital the bilirubin fell steadily from 148 to 30 in 21 days. The course of the icterus was clearly indicated by the quantitative estimation of bilirubin for at least a week before it was visible clinically. This method of detecting the decline or fluctuation of icterus should be of particular value in early differentation of icterus due to obstruction by a malignant growth from one of inflammatory origin. The icterus index fell steadily from 166 to 42, then increased to 50, and then dropped to 31 at the time of discharge. As noted elsewhere, slight degrees of hemolysis, unavoidable in every case even under the best conditions, gave the somewhat misleading appearance of fluctuation in the icterus index at times. Bromsulphalein retention in the 30-minute specimen began at 70 per cent on the second day following admission and dropped at an almost constant rate until the thirteenth day following admission, when it remained at 15 to 20 per cent retention until discharge. All three tests correspond in showing the slowing up of the reparative process in the liver function from the 2d of March on. The relative percentage drop in the three tests also corresponds well throughout the curves as shown in the chart.

This patient never passed entirely out of the condition of clinical jaundice before discharge. The Van den Bergh and Icterus Index clearly show this and the failure of the bromsulphalein excretion to rapidly return to normal as it did in case 1 indicates that some degree of functional impairment still persists.

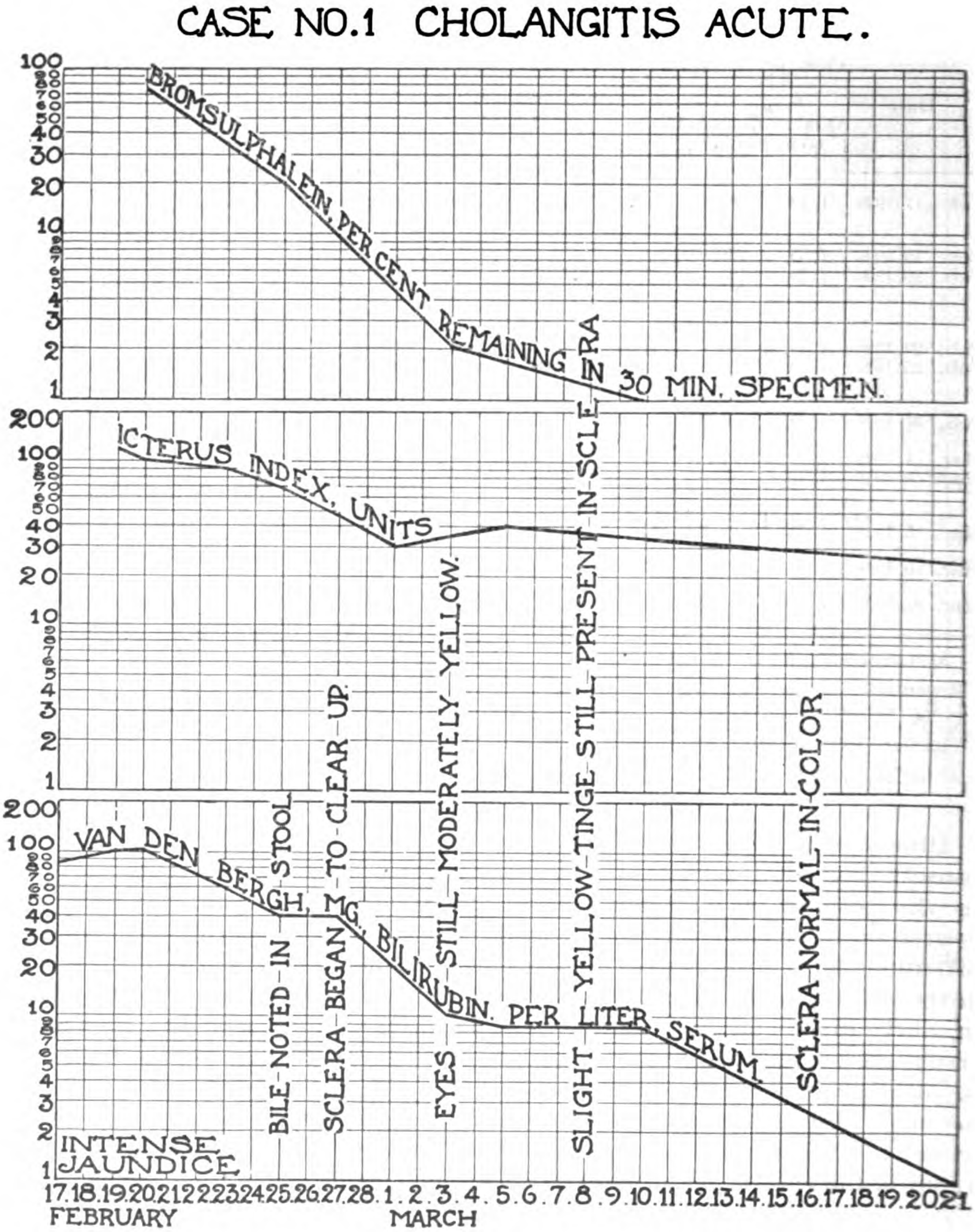

FIG. 2

Case 2

Cholangitis acute. H. L., C., V. B. P.

Date	Van den Bergh		Icterus Index	Bromsulphalein dye retention	Urine	Miscellaneous
	Qualitative	Quantitative				
Feb. 16, 1926	I. D.	148	166	----------	----------	WBC. 5,500, P-60, L-28, LM & T-5 E-4, B-3.
Feb. 18, 1926	I. D.	140	------	15-minute specimen, 70 per cent; 30-minute specimen, 70 per cent; 45-minute specimen, 60 per cent; 60-minute specimen, 50 per cent; 90-minute specimen, 45 per cent; 5-hour specimen, 30 per cent; 26-hour specimen, 15 per cent.	1 hour after bromsulphalein injection urine contained 200 per cent[1] or more than 8 mg. dye per 100 c. c.	
Feb. 20, 1926	I. D.	90	136	----------	Bile 4+ ----------	
Feb. 23, 1926	I. D.	60	91	----------	----------	
Feb. 25, 1926	I. D.	62	70	----------	Bile 4+ ----------	
Feb. 27, 1926	I. D.	60	68	15-minute specimen, 40 per cent; 30-minute specimen, 25 per cent.	----------	Jaundice began to clear up.
Mar. 2, 1926	I. D.	50	58	15-minute specimen, 25 per cent; 30-minute specimen, 15 per cent.	Bile—traces, dye, 40 per cent.	
Mar 5, 1926	I. D.	30	43	15-minute specimen, 35 per cent; 30-minute specimen, 20 per cent.	----------	
Mar. 8, 1926	I. D.	30	42	15-minute specimen, 27 per cent; 30-minute specimen, 20 per cent.	Bile—trace ----------	
Mar. 11, 1926	I. D.	30	50	15-minute specimen, 20 per cent; 30-minute specimen, 15 cent.	Dye in 30-minute specimen, 20 per cent.	
Mar 19, 1926	I. D.	30	31	15-minute specimen, 20 per cent; 30-minute specimen, 10 to 15 per cent.	Bile—negative ------	Slightly jaundiced.

[1] Matched with blood standard.

Patient discharged from hospital March 19, 1926.
Rosenbach-Gmelin test used for bile in urine.
I. D.—Immediate direct reaction.
Van den Bergh quantitative—reported in milligram bilirubin per liter serum.

CASE 3

This civilian case was not under observation for a sufficient length of time for an extensive record but the data obtained do serve to bring out the lack of parallelism between the dye concentration in the blood and in the urine. The concentration of the dye in the urine fluctuated from 250 per cent or 10 mg. per 100 c. c. urine to 80 per cent (3.2 mg. per 100 c. c.), and then up to 200 per cent one hour later. The second observation was made in the period of decline of the jaundice. The jaundice was clinically most intense between April 6 and 9.

Case 3

Cholangitis acute. L. F., Civ.

Date	Van den Bergh		Icterus Index	Bromsulphalein hepatic function test	Urine	Miscellaneous
	Qualitative	Quantitative				
Apr. 6, 1926	I. D.	125	120	----------	Bile 4+.	
Apr. 9, 1926	----------	----------	----------	30-minute specimen, 80 per cent.	30-minute specimen, urine matched 250 per cent standard; 90-minute specimen, 250 per cent, or 10 mg. per 100 c. c.; 2-hour specimen, 80 per cent, or 3.2 mg. per 100 c. c.; 3-hour specimen, 200 per cent, or 8 mg. per 100 c. c.; 4-hour specimen, 150 per cent, or 6 mg. per 100 c. c.; 6-hour specimen, 70 per cent, or 3 mg. per 100 c. c.	
Apr. 16, 1926	I. D.	60	----------	30-minute specimen, 45 per cent.	----------	Jaundice beginning to clear.

I. D.—Immediate direct reaction.
Rosenbach-Gmelin test used for bile in urine.

Case 4

Male, age 25. Complaint, recurrent jaundice.

Has been frankly jaundiced at intervals of several months for past nine years, subicteric tint constantly present between attacks. History otherwise negative. Physical examination negative except for three nonvital teeth, with evidence of chronic apical infection.

Van den Bergh.—Qualitative: Direct reaction, delayed.

Quantitative: Varied from 10 to 21 mg. bilirubin per liter serum on four examinations. Indicative of a nonobstructive type of jaundice (latent). Bromsulphalein; 25 per cent retention; evidences a definite loss of hepatic excretory activity.

On May 14 dental treatment commenced. On May 24, eight days after the removal of three abscessed teeth, the serum bilirubin was 4 and the bromsulphalein retention 20 per cent, showing definite improvement in dye excretion and a sharp drop in bilirubin content. On June 18 the serum bilirubin was 8 and the dye elimination normal. The sclera had in the meantime cleared up markedly and the patient gained 12 pounds in weight and "felt really well for the first time in years."

Case 4

Focal infection, dental. I. A. E., Ph. M. 1c.

Date	Van den Bergh		Icter-us Index	Bromsulphalein hepatic function test	Urine	Miscellaneous
	Qualitative	Quantitative				
Apr. 21, 1926	D. D.	13	25	----------	----------	Sclera have subicteric tint.
Apr. 26, 1926	D. D.	17.6	25	30-minute specimen, 25 per cent.	30-minute specimen, matched, 25 per cent standard; bile—negative.	Do.
May 5, 1926	D. D.	10	------	----------	----------	Do.
May 13, 1926	D. D.	21	25	----------	Bile—negative------	Do.
May 24, 1926	D. D.	4	------	5-minute specimen, 65 per cent; 30-minute specimen, 20 per cent.	----------	Do.
June 18, 1926	D. D.	8	10	5-minute specimen, 45 per cent; 30-minute specimen, none.	Negative----------	Sclera clear.

Rosenbach-Gmelin test used for bile in urine.
D. D.—Delayed direct reaction.
Van den Bergh quantitative—reported in milligrams bilirubin per liter serum.

Case 5

Male, age 25. Complaint, lassitude and lack of energy for past year. No loss of weight; normal 168. Physical examination and history negative except for one nonvital molar with radiolucent area around root.

Diagnosis.—Focal infection, dental.

The qualitative (direct) Van den Bergh was a delayed reaction and the quantitative varied from 5 to 10 on three examinations. Indicative of a nonobstructive type of jaundice (delayed direct reaction), latent degree.

Bromsulphalein retention 25 per cent, indicating diminished liver excretory activity.

Removal of dental focal infection May 18, following which the serum bilirubin dropped to 3 and the 30-minute dye retention to 15 per cent. On June 18 the serum bilirubin was 1.0 and the bromsulphalein elimination normal.

Cases 4 and 5 are apparently examples of a class in which focal infection is responsible for definite liver damage as well as a more rapid destruction of red cells than is normal.

Case 5

Focal infection—Dental; D. W. B., Ph. M. 2c.

Date	Van den Bergh		Icter-us Index	Bromsulphalein hepatic function test	Urine	Miscellaneous
	Qualitative	Quantitative				
Apr. 26, 1926	D. D.	10	19	30-minute specimen, 25 per cent.	30-minute specimen, matched, 25 per cent, standard.	Urine shows trace of alb. Few casts. Bile—negative.
May 3, 1926	D. D.	10	------	----------	----------	May 5, 1926; WBC. 5,500.
May 17, 1926	D. D.	6.5	------	----------	----------	P-54, L-42, LM & T-2, E-2.
May 24, 1926	D. D.	3	------	5-minute specimen, 50 per cent; 30-minute specimen, 15 per cent.	----------	
June 18, 1926	D. D.	1.0	------	5-minute specimen, 45 per cent; 30-minute specimen, none.	Negative----------	

Rosenbach-Gmelin test used for bile in urine.
D. D.—Delayed direct reaction.
Van den Bergh quantitative reported in milligrams bilirubin per liter serum.

CASE 6

Diagnosis.—Cholecystitis chronic. M. F., Civ.

Cholecystotomy performed 12 years ago. A number of stones were removed and gall bladder drained. Several times since then patient has had attacks of soreness in right hypochondrium, at which times he thought he was slightly jaundiced. Free from symptoms at the time of examination.

Van den Bergh: Qualitative—Direct reaction negative. Quantitative—2.5 mg. bilirubin per liter serum.

Bromsulphalein: 5-minute specimen, 50 per cent dye retained; 30-minute specimen, 15 per cent dye retained.

Although serum bilirubin is still within normal limits, dye excretion is definitely diminished.

CASE 7

Diagnosis.—Toxemia of pregnacy. Mrs. M., Civ.

Young woman in the third month of pregnacy. Had been showing definite symptoms of toxemia. Quantitative Van den Bergh slightly above normal (4.0) and bromsulphalein retention of 10 per cent would indicate some degree of liver damage.

Logically the primary anemias, due to their more rapid rate of hemolysis, should show increased serum bilirubin figures; on the other hand, secondary anemias should show normal or low findings. Ravdin (5), using the Van den Bergh, and Bernheim (11) with the Icterus Index, report corresponding results, which indicate that bilirubin determinations should be an important differential point in the anemias. However, accepting the above, our meager experience would indicate that primary anemias during clinical remissions show nothing abnormal as to bilirubin content, the rate of hemolysis apparently being no greater than normal. The secondary anemias uniformly show a low normal bilirubin content; a recent case of Hodgkin's disease with a hemoglobin of 40 per cent gave a scarcely perceptible color in the qualitative Van den Bergh and the direct reaction was long delayed.

Cases of cardiac decompensation often show increased serum bilirubin figures, even showing clinical icterus at times. The bilirubin in these cases gives the prompt direct reaction (indicating obstructive or hepatic origin) and is probably directly proportional to the hepatic malfunction secondary to venous congestion.

SUMMARY

The liver has a number of different and apparently unrelated physiologic functions. Much important work has been done recently in clarifying our knowledge of these functions and in developing clinical methods for their evaluation. Of the clinical tests for liver function which have been developed we have used and con-

sider of value the Van den Bergh, Meulengracht's Icterus Index, and Rosenthal's bromsulphalein dye excretion test.

The Van den Bergh appears to be a valuable test for the differentiation of the two types of jaundice, obstructive and nonobstructive, and for the detection of latent jaundice, as well as the measurement of the amount of bilirubin in the blood. The technique is given in full with a note on calculation in the quantitative reaction and a suggestion as to the preparation of the standard.

The Icterus Index is a simple and easy method of measuring the icteric tint of sera, but for accurate work we believe it should be checked by the Van den Bergh to indentify definitely the yellow pigment in the serum as bilirubin. The technique is given.

Rosenthal's bromsulphalein test appears to be an accurate method for the measurement of the liver's ability to excrete this dye and allied substances. It may detect minor functional defects which other tests fail to bring out. The technique is given.

A few illustrative cases are reported. In acute cholangitis there is a tendency for all of the tests to give parallel data, although the bromsulphalein test probably shows first the return to normal.

Tests for hepatic function are of comparatively recent origin. They will undoubtedly be found of greater clinical value the more they are used. Particularly in diseases of tropical origin is hepatic function practically an untouched problem.

I wish to thank Lieut. Commander K. C. Melhorn, Medical Corps, United States Navy, for case reports four and five, and to express my appreciation of the valued assistance of P. S. Gault, chief pharmacist's mate, United States Navy, and E. A. Kracke, pharmacist's mate, second class, United States Navy.

REFERENCES

1. Carlson, A. J.: Physiology of the liver, J. A. M. A., 85; 20, p. 1468.
2. Mann, Frank C.: Modified physiologic processes following total removal of the liver, J. A. M. A., 85; 20, p. 1472.
3. Greene, Carl H.: The clinical use of tests for hepatic function, J. A. M. A., 85; 20, p. 1476.
4. McNee, J. W., and Keefer, Chester S.: The clinical value of the Van den Bergh reaction for bilirubin in the blood, with notes on improvements in its technique, Brit. Med. Jour., No. 3367, p. 52.
5. Ravdin, Elizabeth Glenn: An estimation of the clinical value of the Van den Bergh test, Am. Jour. Med. Sci., 169; p. 850.
6. Rosenthal, S. M.: Discussion of liver function, J. A. M. A., 85; 20, p. 1549.
7. Opie, Eugene L.: Pathologic physiology of liver in relation to intoxication and infection, J. A. M. A., 85; 20, p. 1533.
8. Shattuck, Browne, and Preston: Clinical value of some recent tests for liver function, Am. Jour. Med. Sci., 170; p. 510.
9. Rosenthal, Sanford M., and White, Edwin C.: Clinical application of the bromsulphalein test for hepatic function, J. A. M. A., 84; 15, p. 1112.

10. Barrows, Armstrong, and Olds: Further clinical and operative studies of the Icterus Index, Am. Jour. Med. Sci., 170; p. 519.
11. Bernheim, Alice R.: The Icterus Index (a quantitative estimation of bilirubinemia), J. A. M. A., 82; 4, p. 291.
12. Barrow, Armstrong, and Olds: A clinical, pathological, and operative study of the Icterus Index, Am. Jour. Med. Sci., 169; p. 583.
13. Andrews: Lancet, 1; 590 (1924). (As quoted by McNee (4).)

CARDIOVASCULAR OBSERVATIONS

Including a Series of Electrocardiograms of 1,812 Men Without Heart Symptoms

By D. Ferguson, Lieutenant Commander, Medical Corps, United States Navy, and J. T. O'Connell, Lieutenant, Medical Corps, United States Navy

The diagnosis of chronic endocarditis in its incipiency may be exceedingly difficult. It has been found necessary to add to cardiac terminology the diagnoses of "potential heart disease" and "possible heart disease." Obviously, recruits with signs of potential or possible heart disease should be rejected.

In order to supplement and check the routine examination of the heart, electrocardiograms were made on 1,812 midshipmen, all of whom, excepting three, were considered to be free from heart disease. The electrocardiographic findings are considered in connection with the history, physical examination, and blood pressure in a series of 822 men.

Discussion of the Diagnosis of Heart Disease

The diagnosis of organic heart disease is usually based on the presence of (*a*) a constant heart murmur, (*b*) cardiac hypertrophy, (*c*) decreased cardiac functional powers, (*d*) a history of an etiological factor.

What is the relative value of these diagnostic points? Are any of them pathognomonic? Are they subject to qualification?

At the present time it is the fashion to ignore all systolic heart murmurs when other signs of heart disease are not found. This is a sound practice only when the murmur originates in the valves at the base of the heart or when it is present only at some stage of respiration—the cardiorespiratory murmur.

The constant mitral systolic murmur should never be disregarded. Cabot (2) reports that in a series of 59 cases of mitral stenosis proved at autopsy the clinical records showed that the only auscultatory finding in 19 cases was a systolic murmur.

The cardiac dimensions in early heart disease can not be relied upon for diagnosis. Cardiac hypertrophy is a most important indication of organic heart disease, but Smith and Bloedorn (1) have

shown the utter impossibility of recognizing beginning enlargement of slight degree.

Response to effort is a very unreliable sign in early, quiescent heart disease. A vigorous, young adult with rheumatic valvular disease may show a better response to exertion than a less vigorous subject having a sound heart. Patients with neurocirculatory asthenia without organic heart disease invariably exhibit on exertion evidence of greater circulatory distress than the average ambulant cardiac patient.

A history of acute rheumatic fever or chorea is highly important in arriving at a diagnosis of heart disease. However, it is well known that the heart may entirely escape injury following these diseases; conversely, chronic valvular heart disease of the rheumatic type occurs in persons who have not had previous rheumatism, chorea, tonsillitis, or other forms of streptococcus infection.

Cardiovascular Observations at the Naval Academy

The routine examination of the heart consisted of the usual physical examination, a family history, a past history, a blood-pressure observation, and an electrocardiographic tracing. When indicated, teleroentgenograms and Wassermann reactions were made at the Naval Hospital, Annapolis.

History.—St. Lawrence (3) examined the families of 100 children who had rheumatic fever, chorea, or rheumatic heart disease. In 50 per cent of these families two or more members had had a rheumatic infection. The work as a whole suggests the necessity for including a family history in the routine recruiting examination.

Cardiovascular-renal disease was found to occur in the families of 822 midshipmen in the following frequency:

	Per cent
Negative family history	92.2
Heart disease:	
Father	.85
Mother	.73
Rheumatism:	
Father	2.4
Mother	1.82
Renal disease:	
Father	1.1
Mother	.4

Of the 822 midshipmen, 188 gave a history of previous tonsillitis, 90 had had scarlet fever, and 18 gave a history of rheumatism.

Pulse rate.—Life insurance statistics (4) show that individuals with pulse rates constantly exceeding 90 per minute, have a mortality rate of 172 per cent, and with pulse rates above 100, the mortality is

205 per cent; 100 per cent being the normal mortality rate for the age. Although no figures are given, the death rate from heart disease, pneumonia, and especially from pulmonary tuberculosis, was above normal.

The Manual for the Medical Department, United States Navy, very wisely requires the rejection of the recruit with persistent rapid heart action.

In some normal persons the pulse may be accelerated by the excitement and worry accompanying the examination. This nervous tachycardia is usually allayed by a rapid stationary run; a few minutes after the run, in normal cases, the pulse rate dropping to its usual frequency.

At the Academy it was found that 6.7 per cent of 822 midshipmen had pulse rates above 90 per minute, and in one-third of these the rate exceeded 100 per minute.

Of the 55 men with rapid pulse rates it was possible to reexamine only 31. On this single reexamination the pulse rate was below 90 per minute in 19 men—61 per cent.

Blood pressure.—Alvarez and his associates (5) studied the blood pressure in a large group of college students and found that it was higher in young male adults than in men of the fourth and fifth decades. They regard a systolic pressure of 140 mm. at 20 years of age as not abnormal.

Theoretically, it is most improbable that a blood pressure which constantly subjects the cardiovascular-renal system to an additional stress of from 10 to 20 per cent is without harmful results.

In a series of 822 midshipmen between the ages of 16 and 20 the systolic blood pressures were distributed as follows: 1.7 per cent below 90 mm. of mercury; 16.1 per cent between 91 and 100 mm.; 64 per cent between 101 and 120 mm.; 12.6 per cent between 121 and 130 mm.; 3.9 per cent between 131 and 140 mm.; 1.8 per cent above 141 mm.

The same factors which cause acceleration of the heart rate at examination also increase the blood pressure. It was possible to reexamine only 33 of the 47 men who had systolic blood pressures exceeding 131 mm. The blood pressure was found below 130 mm. in 73 per cent of them on reexamination.

The 9 midshipmen with systolic pressures remaining above 131 mm. are poor risks for the service. Frost (6) studied 2,568 cases of hypertension occurring in 146,992 life insurance examinations. In 74.7 per cent of the cases of hypertension no evident causation was found. From this study Frost concludes that systolic hypertension without other impairment is associated with a definite increase in mortality directly proportional to the degree of elevation, and this

mortality is due largely to the development of circulatory and renal disease.

In a study of hypotension, Friedlander (7) states that, though a low blood pressure may be an early symptom of tuberculosis, a life insurance series of 3,389 persons with systolic pressures below 110 mm. showed but 33 per cent of the expected mortality. Friedlander also finds that a systolic pressure under 110 mm. in young adults is compatible with perfect health and good bodily vigor. Experience at the Naval Academy confirms this observation.

The Electrocardiograph

The electrocardiograph consists essentially of a string galvanometer and a moving film which photographs the deflections of the string. The patient is placed in the electrical circuit with the string, and after various electrical adjustments are made to compensate for extraneous electrical effects a regular, rhythmic series of deflections occurs, corresponding to the various phases of the cardiac cycle. The cause of these deflections is as follows: When a section of muscle is stimulated at a certain point, that point becomes electronegative to the unstimulated portion. As the wave of stimulation advances, the muscle successively becomes isoelectric, and finally the electrical potential is reversed as the distal portion receives the stimulus. These changes in electrical potential are detectable with a galvanometer. Furthermore, the electrocardiograph permits their intensity to be measured. The film is also marked by a timing apparatus, in order that the time relations may be established.

The normal electrocardiogram.—The excitatory wave causing the heart beat follows regular channels in the normal heart. It arises in the sino-auricular node; spreads in concentric waves through the auricles; arrives at the auriculoventricular node; traverses the bundle of His and the right and left bundle branches; and is finally distributed to the ventricular muscle through the Purkinje network.

The course through the auricle is registered electrocardiographically by the P wave. Normally, this is an upright wave varying in amplitude from a trace to 1.7 tenth millivolts.

During the passage of the wave through the bundle of His there is an isolectric interval which is normally less than 0.2 second.

The ventricular complex consists of the Q, R, S, and T waves. The Q and S are directed downward, and may be rudimentary or entirely absent. The other two waves are directed upward.

The Q, R, and S complexes correspond to the spread of the excitation wave through the bundle branches and the ventricle. The cause of the T wave is not definitely known; it is generally regarded as a deexcitation wave.

R and S have a wide normal zone in amplitude. The duration of the normal Q, R, and S is less than 0.1 second. It constitutes less than one-third of the entire ventricular complex.

The T wave is normally separated from the end of the Q–R–S complex by an isoelectric interval. Normally the T wave is always upright in the horizontal and diagonal leads.

Clinically, three leads are obtained—the horizontal, the diagonal, and the vertical. For convenience they are designated, respectively, leads 1, 2, and 3. The first is obtained from the right arm and left arm; the second, from the right arm and left leg; the third, from the left arm and left leg. They represent the changes in electrical potential which occur through the planes of the heart that their course traverses.

The amplitude of each wave in lead 2 equals approximately the sum of the amplitude of the same wave in leads 1 and 3.

ELECTROCARDIOGRAPHIC OBSERVATIONS

The electrocardiographic findings in 1,812 midshipmen are summarized in Table 1. The figure following the complex named indicates the lead. All the tracings designated as normal had upright P and T waves in all leads, there was no preponderance, and the time relations were within normal limits.

TABLE NO. 1.—*Summary of electrocardiographic findings*

	Number	Approximate percentage
Total number examined	1,812	----------
Normal tracings	944	52
T_3 inverted	153	9
T_3 isoelectric	20	1
T_3 diphasic	77	4
T_3 variable	48	3
Bizarre notching of Q–R–S_3 with T_3 upright	82	5
Bizarre notching of Q–R–S_3 with T_3 inverted	74	4
Bizarre notching of Q–R–S_3 with T_3 variable	18	1
P_3 negative, diphasic, or variable	194	11
P_2 negative, diphasic, or variable	18	1
P_1 negative, diphasic, or variable	1	----------
Axis deviation, right	119	6
Axis deviation, left	115	6
R_2 of less amplitude than R_1 or R_3 (no axis deviation)	18	1
R_2 of less amplitude than 10 tenth millivolts	113	6
Distortion or slurring of R_2	6	⅓
P–R in lead 2 greater than 0.2 second	26	1½
Q–R–S in lead 2 greater than 0.1 second	2	----------
T_2 inverted or diphasic or isoelectric	8	½
Sino-auricular block	2	----------
Premature contractions (extrasystoles)	27	1½
Chief deflection downward in all leads	5	----------

NEGATIVE T WAVES AND BIZARRE NOTCHING OF Q–R–S

No importance is attached by most authorities to inversion of the T wave or to notching of Q–R–S when they occur only in lead 3.

Certain poisons, notably digitalis, and stimulation of the vagus and sympathetic nerves produce inversion of the T wave.

Nixon (8) believes that negativity of T_3 depends on cardiac atony. He finds the T wave becomes upright when toxemias are relieved and the cardiac tone restored.

In the Naval Academy series 64 instances occurred in which T_3 varied from a definite negative to a frank positive deflection in the same tracing. The changing T waves in this series are probably due to change in the electrical axis of the heart or to changes in the vagus-sympathetic balance.

Wilson and Herrmann (9) found notching of Q–R–S in lead 3 of common occurrence. They distinguished between normal and abnormal notching. The former is confined to the lead of smallest amplitude (lead 3) and the notching occurs relatively close to the base line. In abnormals the notching is usually present at the apex of the deflection and in leads of largest amplitude.

In the Naval Academy series notching of Q–R–S occurred 174 times—almost 10 per cent. In every instance it was confined to lead 3.

Negative T waves in leads 1 and 2 are often associated with cardiac pathology. Willius (10) studied the prognosis in a large series of cases showing various combinations of inverted T waves in leads 1, 2, and 3. He found that the following percentages of cases having inverted T waves died a cardiac death within four years: Nine per cent of cases with inverted T_3 only; 33 per cent with inverted T_2 and T_3; 66 per cent with T_1 only inverted; 50 per cent with T_1, T_2, and T_3 inverted; and 67 per cent with T_1 and T_2 inverted.

In the Naval Academy series eight instances occurred in which T_2 was negative, isoelectric, or diphasic; T_3 was also negative in all of these tracings. It was possible to take a second tracing on only five of these men. In all except one the second tracing showed an upright T_3. None of these cases had evidence of heart disease and none were receiving digitalis. These cases illustrate the necessity for a second tracing when the electrocardiographic findings are at variance with the clinical. No tracings showed inversion of the T in lead 1.

One instance occurred in which there was notching of an upright T wave in all leads; this notching was also present on reexamination in a second and a third tracing.

No instances of notching of R in leads 1 and 2 occurred, but a slurring of the descending arm of R_2 occurred in six tracings. There was no prolongation of the duration of Q–R–S beyond the normal limit, nor any other abnormality present in these tracings.

NEGATIVE P WAVES

Inversion of P waves in all leads indicates that the pacemaker has been displaced from the sinoauricular node. Ectopic auricular contractions (auricular extrasystoles) are shown as inverted P waves.

In the Naval Academy series inversion of P_3 occurred 194 times—11 per cent. In 76 tracings of this series P_1 was of greater amplitude than P_2. This combination of events indicates that the center of impulse formation is located low in the sinoauricular node.

Although Goddard (11) found practically no agreement between the amplitude of the P wave and the size of the auricle at necropsy, White and Burwell (12) found abnormally high P waves in lead 2 (exceeding 2 tenth millivolts) in 77 per cent of 57 mitral stenosis cases with regular rhythm.

PREPONDERANCE OR AXIS DEVIATION

Preponderance or axis deviation occurs when the S wave in lead 1 or in lead 3 is of greater amplitude than the R wave in the same lead. This imbalance results when the electrical axis of the heart is moved to the left or right. The usual cause for the abnormal position of the electrical axis is hypertrophy or dilatation of the chambers of the heart; but the electrical axis may occupy, in normal persons, such an angle that curves of right or left preponderance are obtained (12, 13, 16).

The degree of right or left axis deviation, or preponderance, is determined by the equation $(R_1+S_3)-(R_3+S_1)=\text{Index}$. The measurements are of amplitudes of the string excursions expressed in tenths of a millivolt.

Although Herrmann (14) has shown that there is practically no relation between preponderance and ventricular weights at necropsy, White and Bock (15) found the index in 82 per cent of right heart hypertrophies (indicative of mitral or pulmonic stenosis) more minus than -15, and in 74 per cent of left heart hypertrophies it exceeded $+20$.

White and Burwell (12), using White and Bock's formula, do not regard axis deviation as pathological unless right axis deviation is more minus than -10, and left axis deviation exceeds $+20$. They found that abnormal right axis deviation occurs in 8 per cent of normal people, in 47 per cent of uncomplicated mitral stenosis, in 100 per cent of uncomplicated pulmonic stenosis, in 2 per cent of uncomplicated hypertension, and in 4 per cent of uncomplicated aortic regurgitation cases. They found that abnormal left axis deviation occurs in 11 per cent of normal people, in 7 per cent of uncomplicated mitral stenosis, in 55 per cent of uncomplicated hypertension, and in 50 per cent of uncomplicated aortic regurgitation cases.

In the Naval Academy series axis deviation occurred 234 times—115 left and 119 right. This compares with Cohn's series of 208 normal soldiers in which left axis deviation occurred six times and right axis deviation three times.

Pathological deviation, according to White and Burwell's standard, occurred in the Naval Academy series as follows: Left axis deviation greater than +20 in 10 cases (one-half of 1 per cent); right axis deviation more minus than —10 in 95 cases (5 per cent).

In curves of axis deviation it is usually found that the R wave of greatest amplitude occurs in either lead 1 or lead 3. At some clinics the diagnosis of preponderance or deviation is not made if the largest R wave occurs in lead 2. In our series of 234 cases of preponderance, R in lead 1 or 3 was greater than R_2 in 120 tracings; R in lead 2 was greater than R_1 or R_3 in 114 tracings.

A second tracing was made in 70 cases of axis deviation, and no axis deviation was found in 18 on reexamination. The R wave in lead 2 was greater than R_1 or R_3 in the first tracing in 83 per cent of the 18 cases which failed to show axis deviation in the second tracing. However, R_2 was greater than R_1 or R_3 in 27 per cent of the cases which showed axis deviation in both tracings.

Teleroentgenograms were made in 48 of the cases of axis deviation to determine if cardiac hypertrophy existed. Table 2 shows the degree of axis deviation and the cardiothoracic ratio. The latter is obtained by dividing the transverse diameter of the heart by that of the internal diameter of the thorax taken at the level of the nipples. A ratio greater than 53 per cent is considered by many authorities to indicate hypertrophy of the heart, although Smith and Bloedorn found the ratio exceeded this figure in 14.6 per cent of 410 normal midshipmen.

TABLE No. 2

ECG number	Axis deviation	MR to TD ratio	Cardiothoracic ratio	ECG number	Axis deviation	MR to TD ratio	Cardiothoracic ratio
60	+22	37	50	265	+6	40	41
295	+20	39	48	359	−25	36	41
80	+20	33	46.5	368	−24	38	46
62	+20	44	42	189	−24	33	42
194	+18	40	45	266	−23	34	40
430	+18	36	51	134	−23	34	46
435	+18	37	40	16	−22	31	45
106	+17	30.5	39	515	−22	37	42
336	+16	40	46	47	−19	25	43.5
859	+15	35	49.5	130	−18	30	43
459	+13	37	42	90	−18	43	45
205	+13	29	41	58	−17	41	45
347	+13	33	48	82	−17	29	46
455	+13	37	46	8	−17	32	41
391	+12	35	48	487	−16	38	39
234	+12	39	43	220	−16	39.5	45.5
151	+11	31	40	32	−16	24	55
81	+10	36	45	6	−15	40.5	42
41	+10	32	46	88	−13	38.5	42.5
457	+11	40	45	502	−13	46	46
390	+10	34	46	48	−12	32	38
286	+10	33	53.5	436	−11	31	44
267	+8	35	43	196	−8	31	44
158	+8	50	43	11	−8	34	43

NOTE.—Comparison of the extent of axis deviation with the heart size as determined by the cardiothoracic ratio. The ratio of MR to TD is also given for comparison. The plus sign (+) indicates left and the minus sign (−) right axis deviation.

Cohn (13) showed in his study of the relation of the position of the heart to the electrocardiogram that (*a*) in presumably healthy men curves resembling preponderance are obtained; (*b*) the anatomical angle of the heart is small, when deep S waves occur in lead 3, the anatomical angle is large when deep S waves occur in lead 1; (*c*) when S is deep in lead 3 inverted T waves are common.

In Table 3 are shown the degree of axis deviation, the anatomical angle of the heart, the transverse diameter of the heart, and the cardiothoracic ratio in 21 midshipmen. The transverse diameter, calculated from body surface area and corrected for the heart's anatomical angle, by Smith and Bloedorn's (1) method, is shown for comparison with the cardiothoracic ratio. The ratio of MR to TD was obtained in order to determine if any relationship existed between the type of axis deviation and the amount of the heart lying on either side of the mid-line.

TABLE NO. 3.—*Comparison of the essential factors in the different types of axis deviation*

	Index	Angle	TD	Calculated normal TD from surface area corrected for cardiac angle	Cardiothoracic ratio	MR to TD ratio
Left axis deviation; R_1 greater than R_2	+14	44	12.5	....	47	28
	+4	53	13.1	....	50	36
	+16	53	12.1	11.7	41	41
	+22	35	13.5	....	46	33
Left axis deviation; R_2 greater than R_1	+17	41	12.9	....	43	36 T_3-
	+9	38	14.9	....	54.5	41 T_3-
	+9	47	14.4	11.4	51	28
	+8	45	12.5	12.2	48	39
Left axis deviation; S_3 exceeds R_3	+12	50	12.4	10.9	43	38
	+4	53	11.5	....	43	32
	+8	53	11.9	....	44	30
Right axis deviation; R_3 greater than R_2	−25	49	12.5	12.0	42	33
	−11	51	11.5	11.4	44	33
	−24	45	11.4	11.5	40	26
	−17	45	12.5	12.5	45.5	33
	−21	57	10.9	10.3	40	40
Right axis deviation; R_2 exceeds R_3	−14	53	11.1	11.9	40	38 $T_3+\&\pm$
	−19	44	12.2	....	43	38 $T_3+\&-$
	−20	45	12.9	11.9	41	30 T_3-
	−18	44	11.1	12.8	44	25
	−15	55	11.3	10.7	43.5	35

On examining Table 3 it is apparent that no relation exists between the extent of axis deviation and the size of the heart. The arithmetical average of the cardiac angles in the cases of left axis deviation is 44.7° and the average for the series of right axis deviation is 52.8°.

The discrepancy existing between the electrocardiographic and X-ray findings is in all probability due to a rotation of the heart on its vertical axis. This rotation is caused by the heart's contraction and the diaphragmatic excursion.

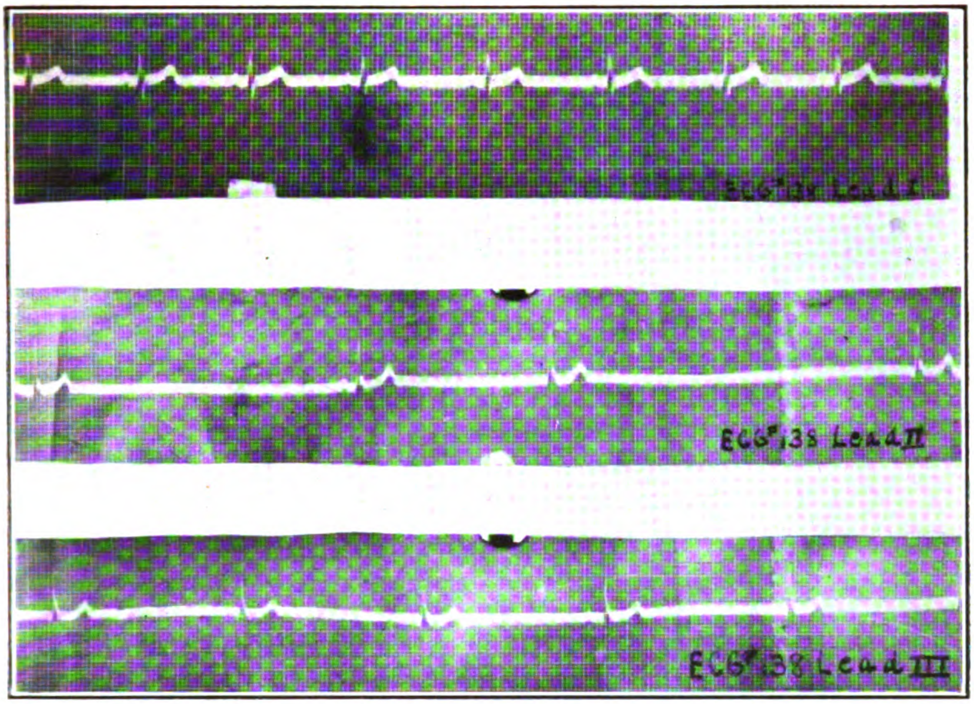

FIG. 1.—ELECTROCARDIOGRAM NO. 138. LEAD I SHOWS NORMAL RHYTHM. LEADS II AND III SHOW SINO-AURICULAR BLOCK WITH UNUSUALLY LONG INTERVALS BETWEEN VENTRICULAR CONTRACTIONS. IN THIS AND THE FOLLOWING TRACINGS TIME IS IN $\frac{1}{5}$ SECOND AND $\frac{1}{25}$ SECOND; DEFLECTIONS STANDARDIZED TO 1 MILLIVOLT = 1 CM.

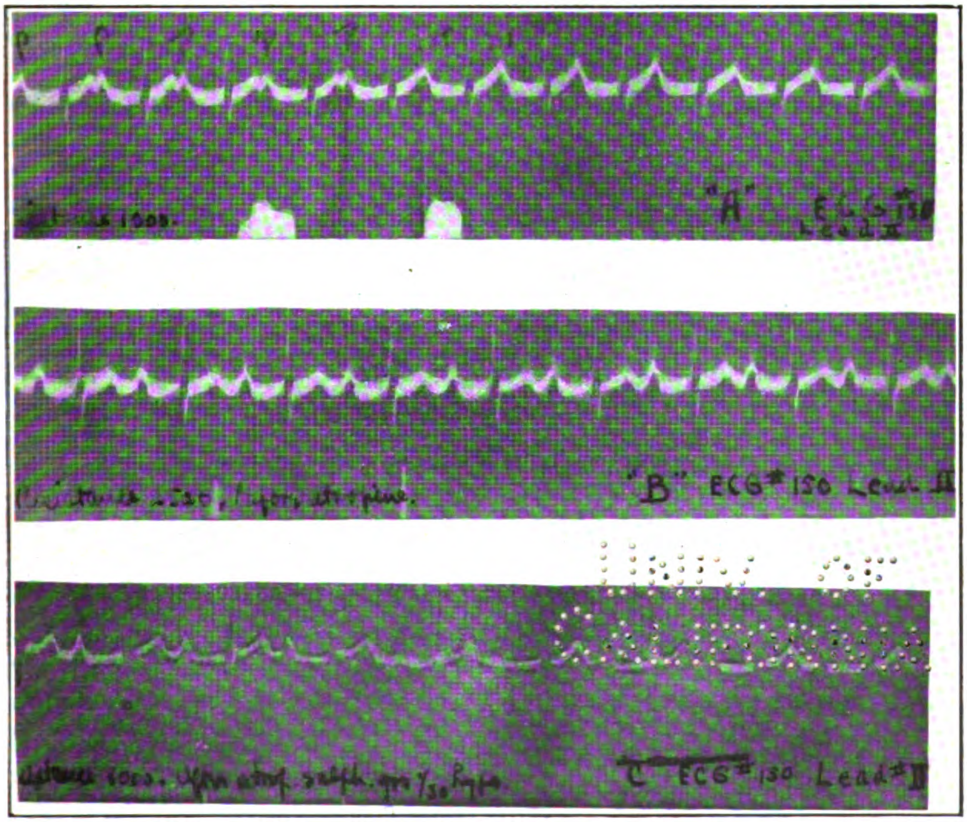

FIG. 2.—ELECTROCARDIOGRAM NO. 150. "A" SHOWS P FALLING ON T WHEN THE RATE ATTAINS 120 PER MINUTE. "B" SHOWS P AND T SEPARATED; RATE 84. "C" WAS TAKEN AFTER ATROPINE AND SHOWS THE P-R INTERVAL NOT SHORTENED. THE LARGE P WAVES SUGGEST AURICULAR HYPERTROPHY WHICH WAS NOT DEMONSTRABLE

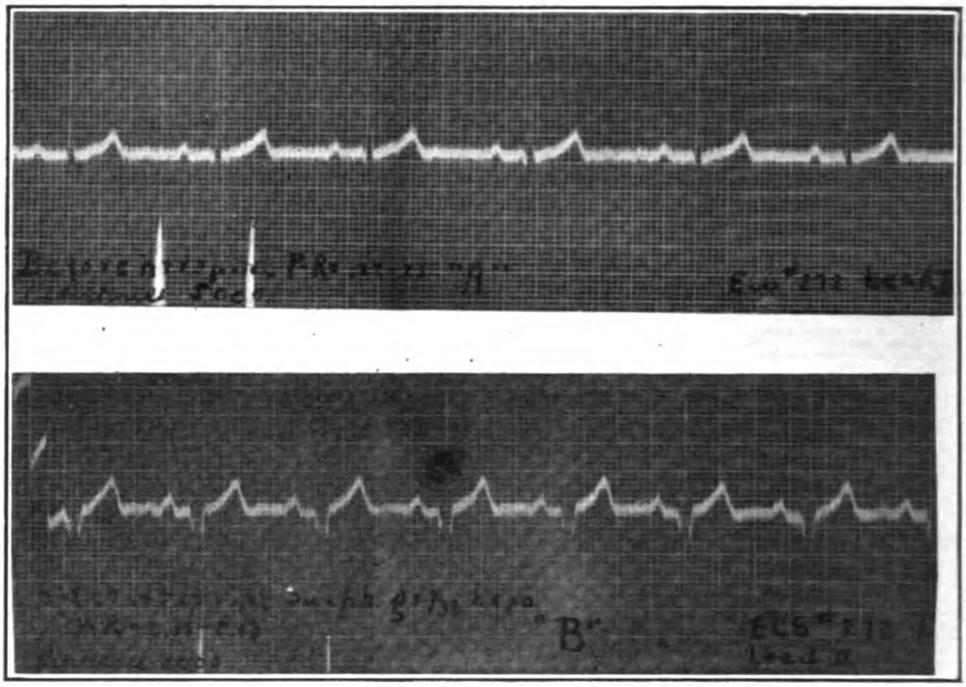

FIG. 3.—ELECTROCARDIOGRAM NO. 272. "A" SHOWS A P–R INTERVAL OF 0.22–0.23 SECOND BEFORE ATROPINE. "B" SHOWS P–R INTERVAL TO BE 0.17–0.18 SECOND AFTER ATROPINE SULPHATE, GR. $\frac{1}{30}$ HYPODERMICALLY

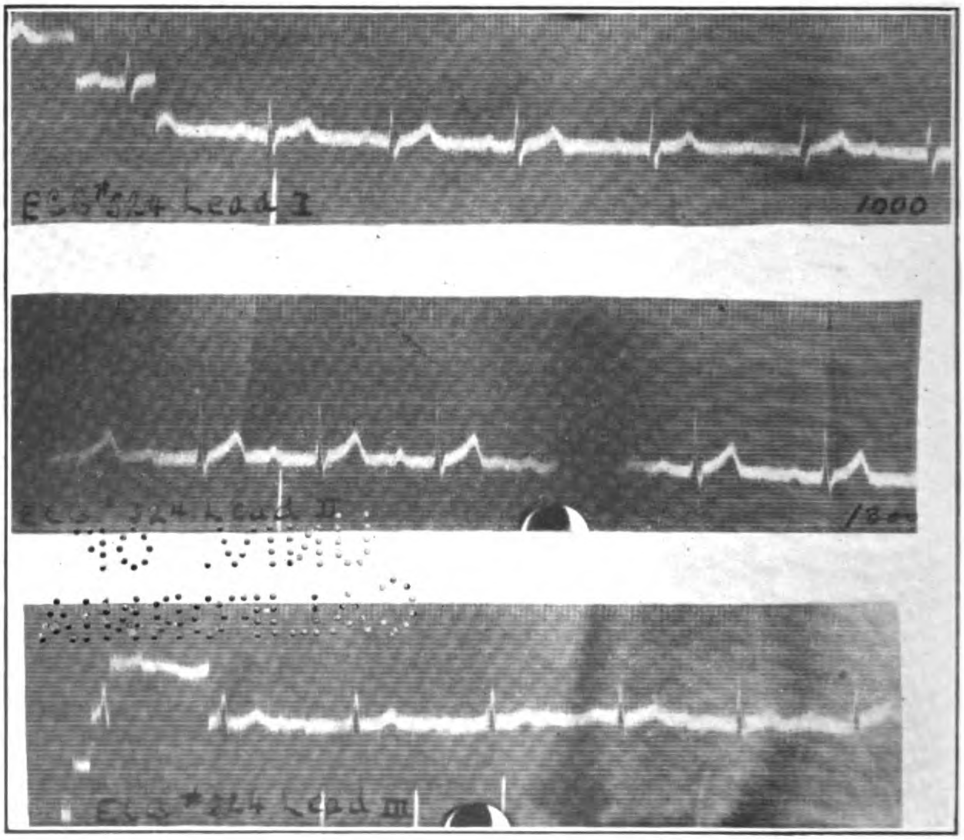

FIG. 4.—ELECTROCARDIOGRAM NO. 524. THE P–R INTERVAL VARIES FROM 0.26 TO 0.38 SECOND

THE AMPLITUDE OF THE R WAVE IN LEAD 2

In 18 tracings, about 1 per cent, there was no evidence of axis deviation but the R wave in lead 2 was of less amplitude than R in lead 1 or lead 3. This combination of events was due probably to some physiological positional change in the electrical axis occurring in the intervals between leads. Subsequent tracings should show different relations.

The average normal amplitude of R_2 is 10.32 tenth millivolts and the minimum normal amplitude is 4, as determined by Lewis and Gilder (16).

Ventricular deflections of low amplitude have been observed in hypothyroidism and in cases of myocardial weakness due to coronary sclerosis (17).

Einthoven (18) recently presented evidence which shows the incorrectness of the theory that an electrical excitation wave precedes mechanical activity of the heart. He showed that the electrical and the mechanical waves are not only synchronous but also tend to correspond in amplitude and duration.

In the Naval Academy series R_2 was of less amplitude than 10 tenth millivolts in 113 tracings—6 per cent; it was less than 4 tenth millivolts in 2 tracings, both of which on reexamination, however, showed R waves greater than 4.

DISTORTION OF R IN LEAD 2

Notching and slurring of R_2, when accompanied by prolongation of the duration of Q–R–S beyond 0.1 second, is often found when severe myocardial damage exists. When associated with axis deviation and a T wave which is in the opposite direction to the chief ventricular deflection, these findings are diagnostic of bundle-branch block. Lewis has shown that the duration of Q–R–S may exceed 0.1 second in left axis deviation due to left ventricular hypertrophy. He distinguishes between bundle-branch block and axis deviation by the direction of the T wave. Wilson and Herrmann (14), however, find in 50 per cent of tracings of preponderance the same T waves as in bundle-branch block.

In the Naval Academy series distortion of R_2 occurred six times—one-third of 1 per cent. In all cases the distortion was an asymmetrical slurring of the descending arm of R. In all six tracings the duration of Q–R–S was within normal limits, there was no abnormality of the T waves, nor was there axis deviation.

P–R INTERVAL EXCEEDING 0.2 SECOND

Lewis and Gilder found the P–R interval to be between 0.13 and 0.21 second in 53 normal subjects. A P–R interval exceeding 0.2 second is generally considered to be due to auriculoventricular heart block, when it can be shown that it is not the result of vagal stimulation. The three grades of heart block are readily distinguished in the electrocardiogram. Heart block of the first degree is shown as a simple prolongation of the P–R interval beyond 0.2 second. In second degree heart block the P–R interval increases in each succeeding cardiac cycle until a P wave occurs which is not followed by a ventricular deflection. The Q–R–S is omitted because the descending excitation wave from the auricles arrives at the auriculoventricular bundle when the bundle is in the refractory phase from the preceding cardiac cycle. The wave is blocked, the bundle has a longer period to regain its tone, and the succeeding wave is transmitted with increased promptness through the bundle. The procedure is then repeated.

In third degree heart block, or complete heart block, there is complete dissociation between auricle and ventricle. The ventricle develops its own pacemaker, whose rate is about 38 per minute.

In the Naval Academy series the P–R interval exceeded 0.2 second in 26 tracings—about 1.5 per cent. In five instances the P–R interval in lead 2 was constantly at 0.21; in one tracing it varied from 0.18 to 0.21 second; and in three tracings it varied from 0.19 to 0.21 second.

In three tracings it was of 0.22 second duration constantly and in two tracings it varied from 0.18 to 0.22 second.

In one tracing it varied from 0.19 to 0.24 second and in another it ranged from 0.2 to 0.24 second. In one tracing it varied from 0.22 to 0.23 second.

In three tracings PR_2 varied from 0.2, 0.22, and 0.23 second to 0.25, respectively.

In one tracing PR_2 varied from 0.23 to 0.26 second. In one tracing it was constant at 0.29 second. In another it varied from 0.26 to 0.38 second.

The atropine test was given to four midshipmen whose tracings showed prolonged P–R intervals. The atropine paralyzes the peripheral nerve endings; therefore if the prolonged P–R interval is due to vagal stimulation acting on the fibers which terminate in the bundle, the vagus effects will be abolished or considerably arrested. Atropine sulphate, gr. $\frac{1}{30}$, was given hypodermically, and the characteristic atropine effects on the pupils and throat were observed before additional electrocardiograms were made.

Case 150, which showed a P–R interval of 0.29 second quite constantly, showed no shortening of the interval after atropine. Case 205, in which PR_2 varied from 0.22 to 0.25 second, showed, after atropine, a P–R interval of 0.22 second constantly. Case 247, in which PR_2 varied from 0.23 to 0.26 second, showed after atropine, a P–R interval of 0.2 second constantly. In case 272, the P–R interval was reduced by atropine from 0.22–0.23 second to 0.18 second.

Case 150 was entirely unaffected by atropine. His past and family history was unimportant and the physical examination was entirely negative. During a prolonged exercise test his pulse rate attained 130 per minute, but no irregularity, indicative of dropped ventricular contractions, occurred. The heart's response to exertion was excellent.

None of the cases of prolonged P–R interval exhibited any degree of prolongation of the Q–R–S interval. None gave a history of rheumatic fever, chorea, or diphtheria, nor were physical signs of heart disease present.

In case 524 the P–R interval varied from 0.26 to 0.38 second. The physical examination was entirely negative and the heart's efficiency was unimpaired. This man was an oarsman and rowed 3 miles in an eight-oared shell without difficulty.

In the three cases affected by atropine the prolonged P–R intervals were evidently due entirely to vagal effects. Although in case 205 the P–R interval did not fall within 0.2 second, the probabilities are that it would have done so had the dose of atropine been increased.

Case 150 is impossible of exact interpretation. It is not believed that the anomaly is due to organic heart disease, in view of the negative clinical findings. The following explanation of the condition is possible: White and Burwell state that it is probable that there is an individual variation in the architecture of the auriculoventricular bundle in different people. P. D. White believes that it is equally probable that physiological or functional variation of wide degree also occurs. This explanation was assigned. Time alone will establish its accuracy.

Two tracings showed a Q–R–S interval of 0.11 second, with no other abnormality. These cases were regarded as physiological variations also.

EXTRASYSTOLES

Premature contractions, or extrasystoles, were found in 27 tracings, about 1½ per cent. In five tracings auricular extrasystoles occurred; two were of nodal origin and 20 were of the ventricular type. The irregularity disappeared on exercise in all these cases.

Two cases of sinoauricular block occurred. The cause assigned in both cases was vagus-sympathetic imbalance.

In five tracings the chief ventricular deflection was directed downward in all leads. The cause for this is most probably a change in the direction of the electrical axis of the heart. A reexamination could be made in only one case. This second tracing showed the normal, upright R wave.

HEART MURMURS

The physical findings and the electrocardiograms of a group of 522 midshipmen were examined. The physical examination was entirely negative in 45.5 per cent of this group. A systolic murmur at the base was present in 51 per cent. In 31 per cent of the entire group the basic systolic murmur only was present and the electrocardiogram was essentially negative. In 6 per cent a cardiorespiratory murmur was also present. Axis deviation occurred with a basic systolic murmur in 8 per cent—right axis deviation 4.5 per cent and left axis deviation 3.5 per cent. Pathological right axis deviation occurred in 16 of the 24 cases. None of the 18 cases of left axis deviation were of a pathological degree. In the remaining 6 per cent with basic systolic murmurs the following electrocardiographic abnormalities were found in about the same frequency that occurred for the group of 1,812 men: Prolonged P–R interval, R_2 of less amplitude than 10 tenth millivolts; inverted P_3; bizarre QRS_3; inverted T_3. In 2½ per cent a cardiorespiratory murmur was present without the systolic murmur at the base.

One man had a constant mitral systolic murmur. He was reluctantly accepted in conformity with the instructions in the Manual for the Medical Department, as other evidences of heart disease were lacking, although the diagnosis of functional mitral regurgitation can not be made with any degree of certainty at a single examination. No diastolic murmurs were found in the examination of any of these men. Although functional diastolic murmurs at the base occur, only one was encountered during the examination of the hearts of some 5,500 men. This diagnosis should be made with great reserve, as organic aortic regurgitation may occur in a heart that is not enlarged. In one such case, teleroentgenograms made after a year elapsed did not show any increased enlargement.

SUMMARY

Electrocardiograms were made to supplement the physical examination of 1,812 men with regularly beating hearts and without cardiac symptoms.

Teleroentgenograms were made in 69 cases showing the various types of axis deviation.

Blood pressure and pulse rate observations and the family and past medical histories in 822 midshipmen are given.

Physical signs are considered with the electrocardiograms in 522 midshipmen.

CONCLUSIONS

Electrocardiograms proved of no value in assessing the heart's condition in 1,809 men, who, after careful examination by a board of experienced examiners, were believed to have normal hearts. Certain anomalies were found which could not be demonstrated as pathological. In cases of doubtful cardiac pathology, without cardiac symptoms, the decision rested on the results of the physical examination.

In 99 per cent of normal young men the systolic blood pressure was found to be less than 130 mm. Hg.

REFERENCES

1. Smith, H. W., and Bloedorn, W. A.: The size of the normal heart, U. S. N. Med. Bull. XVI; 219, (Feb.) 1922.
2. Cabot, R. C.: Physical diagnosis, 8th ed. 1923. Wm. Wood, N. Y.
3. St. Lawrence, W.: The family association of cardiac disease, J. A. M. A., 79 : 2051, (Dec. 16) 1922.
4. Fiske, E. L.: Personal communication.
5. Alvarez, W. C., and Wulzen, R. and Mahoney, L. J.: Blood pressures in 15,000 university freshmen, Arch. Int. Med., 32: 16, (July) 1923.
6. Frost, H. M.: Hypertension and longevity, Boston M. & S. Jour., 193 : 241, (Aug. 6) 1925.
7. Friedlander, A.: Clinical types of hypotension, J. A. M. A., 83 : 167, (July 17) 1924.
8. Nixon, H. C.: The heart in chronic toxemia, British M. J., 1 : 692, (Apr. 11) 1925.
9. Wilson, F. N., and Herrmann, G. R.: Bundle-branch block and arborization block, Arch. Int. Med., 26 : 153, (Aug.) 1920.
10. Willius, F. A.: Am. J. M. S., 160 : 844, (Dec.) 1920.
11. Goddard, C. H.: Changes in the P wave of the human Electrocardiogram, Arch. Int. Med., 16 : 633, (Oct.) 1915.
12. White, P. D., and Burwell, C. S.: The effects of mitral stenosis, aortic regurgitation and hypertension on the electrocardiogram, Arch. Int. Med., 34 : 529, (Oct.) 1924.
13. Cohn, A. E.: An investigation of the relation of the position of the heart to the electrocardiogram, Heart, 9 : 311, (Dec.) 1922.
14. Herrmann, G. R.: Electrocardiography and cardiac pathology. Thesis for the degree of Ph. D., U. of Mich., 1923.
15. White, P. D., and Bock, A. V.: Electrocardiographic evidence of abnormal ventricular preponderance and of auricular hypertrophy, Am. J. M. S., 156 : 17, (July) 1918.
16. Lewis, T., and Gilder, M. D. D.: Quoted in The Mechanism and Graphic Registration of the Heart Beat by T. Lewis. Hoeber, New York, 1920.

17. Thatcher, C., and White, P. D.: The electrocardiograph in myxedema, Am. J. Med. Sci., 171 : 61, (Jan.) 1926.
18. Einthoven, W.: The Dunham Lectures, Harvard Medical School, (Oct.) 1924. Quoted by White, P. D., and Sprague, H. B. Progress in study and treatment of Cardiovascular disease in 1924, Boston M. & S. J., 192 : 853, (Apr. 30) 1925.

FLIGHT ACCELERATIONS AND EQUILIBRIUM

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The following notes are based on the experiences and observations of the writer during 14 years of flying. The sensations experienced in flight differ in many instances from those ordinarily experienced, and, until the flyer becomes accustomed to them, affect not only his interpretation of the conditions encountered, but his actual efforts to effect the necessary operation of the controls of the plane to regain or maintain the required attitude of the airplane. Under ordinary conditions few of us realize the degree to which we depend upon the senses in our recognition of the conditions of equilibrium, or just what senses are involved, particularly when we are affected by accelerations other than or in addition to gravitation. The eyes, the canals of the ears, and muscular sense are essential and interdependent in arriving at a correct determination of our different attitudes.

In piloting two distinct types of coordination are involved. First, observation, and, second, operation of the controls of the plane. The first may be termed subjective coordination or observation in a broader sense than that of mere vision, and the second, objective or operative coordination. The accelerations encountered in flight tend at first to confuse both types of coordination and both require practice to bring out the nicety in observation and action necessary.

The eyes, of course, are our range finders and under steady condition of motion are the principal means we have of recognizing motion to, from, or by objects which are visible. The canals of the ear are sensitive to accelerations, and, under steady conditions, recognize the acceleration of gravitation, enabling us, no matter what the attitude of the body, to determine the true vertical. The muscular sense enables us to appreciate the forces acting on us, and, under steady conditions, assists in determining our attitude, and, in flight, also combined with the sensation of touch, assists us in determining speed from the pressure of the wind, if exposed to same. The sense of sound is of further assistance to us in flight, in apprising us of the velocity of the plane through the rush of air or the whistling of the wires in the airplane rigging, or in apprising us of the functioning of the engine, but these latter are of no as-

sistance in determining equilibrium. The muscular sense also is of practically no use in determining equilibrium except that, indirectly, it informs us whether we are slipping or skidding.

The senses just referred to are subject to deception in flight, due to a variety of causes. These may best be illustrated by a review of certain experiences, some of which are commonplace. But these will serve to demonstrate certain facts, viz:

Any accelerations involved, other than gravitation, are compounded with gravitation producing a resultant acceleration, and only this resultant can be determined by the canals of the ear or by the muscular sense, and this resultant is seldom the true vertical.

The eyes are subject to two effects closely allied, which may be termed "persistence" and "anticipation"; both of them reflex muscular actions which accomplish focusing and orientation of the eyes. Both are very useful once acquired.

Suppose we stand on a bridge over a swift stream and concentrate our gaze in a fixed direction. In a few seconds a sense of motion is experienced so that it appears the bridge is moving and not the water. A quick shift of the eyes to the shore results in a sort of surprise, almost a shock, at the cessation of the sense of motion. The effect is entirely due to vision.

Again, look out of the window of a train, gaze at some near object; if too near it flashes by in a blurred streak and no definite image except streak is formed, yet a definite point may be selected and recognized by swiftly rolling the eyes sidewise. Now look at a particular object at some distance and note the apparent motion of more distant and of intermediate objects. If looking out the right side of the train, the more remote objects appear to move to the left and the less remote to the right; to a degree the landscape appears to rotate anticlockwise about the reference object. Yet, if a more remote object is quickly selected, the original object will now appear to move to the right. Definite effort of the eye muscles will be recognized as necessary to accomplishing these observations.

Again, close the eyes as a train gets under way or slows down. In the first case it will feel as if the train is going uphill; in the second, downhill. Both sensations are the result of muscular effort to sit perpendicular to the resultant acceleration and to effects on the canals of the ear.

The writer has noted some effects, due it is believed to a degree of sensitiveness resulting from flight training, viz:

As a train slows down, temporarily buildings appear to be out of plumb, and the same effect is noted when rounding a sharp curve. In these cases it would appear that the eyes, the ears, and the muscles combine in providing the deception which appears to

involve the action of the eye muscles in "anticipation" of the expected position of the objects.

Perhaps a more striking illustration may be drawn from an actual flight experience. While training for piloting, I, at one time, had had no opportunity to fly for some months. On my next flight I started down for a landing from about 500 feet. I was surprised to note that the surface of the bay appeared to be mushroomed and higher at the point I aimed at than elsewhere. On my next landing this effect was no longer present. This I attribute to failure of my eyes to pick up the trick of "anticipation" on the first landing, but to picking it up again as a reflex action on the second landing.

Deception is well illustrated by the "tumbling room" and "going up." The tumbling room is an amusement device in which the audience assembles on benches in a room hung on a shaft. As soon as the audience is seated the platform on which they are seated gives a lurch up at front, then the walls of the room revolve about the axis on which the platform is hung. The lurch destroys the reference to the vertical and the testimony of the eyes dominates that of the ears. The illusion is nearly perfect.

"Going up" is a parlor game in which the "victim" is blindfolded, instructed to stand on a plank, and place his hands on the shoulders of the person in front of him to steady himself. The plank rests on books or low blocks with a person at each end to lift when told. When told to lift, they raise the plank about 1 inch then continue it in slight motion at that level. The person in front proceeds to stoop lower and lower. The victim has a very definite sensation of being lifted to a considerable height, and if told to jump will usually fear to do so. In this case again the reference point is lost by the insecurity of the support.

The swing and the loop-the-loop both illustrate muscular sense of variation in weight; with the eyes closed the true vertical is difficult to determine.

The conical swing combines the effects of the swing and the merry-go-round, and the proportions of the combination may be varied. Centrifugal force is compounded with gravitation, and the apparent vertical and weight are different from the real. The merry-go-round frequently develops the effects of both "persistence" and "anticipation."

Spinning in a chair, or rapid turning, produces both these effects which are the cause of the unsteadiness which follows.

In bicycling, the eyes and the ears both assist in determining the vertical on a straight path, and the ears the resultant on a curved path, enabling the correct "bank" to be determined with nicety.

Actual flight.—In level flights at constant speed, straightaway, the only sense of motion is that derived from the air speed and vision

of passing objects. The cells of the ears enable a true estimate of the vertical. If the power is increased, and the plane thus accelerated, the ears and the muscular sense indicate the resultant with gravitation to be inclined to the rear and downward, at first a desire to incline forward is felt and the contrary is true of the effects of retardation. Similar effects in the same order are presented in a steady climb or glide, but ordinarily the body movements are restricted by the cockpit arrangement and the seat straps. Lateral or longitudinal deviations of the plane from level position are readily detected even with the eyes closed. Changes in direction, unless very violent, are detectable only through the evidence of vision.

Vertical accelerations due to puffs result in a sharp sense of decrease or increase in apparent weight, depending upon whether a drop or rise is encountered. In rough air it is not uncommon for the passenger to be lifted clear of the seat, in which case the downward acceleration of the plane is equal to or greater than gravitation, but it may also happen on a less acceleration if the muscles are set to carry one's weight and they do not instantly relax.

Lateral accelerations are also encountered in rough air, and result in a sharp sense of falling toward the side from which the force is impressed.

When turning at a considerable rate there is but little sense of increased weight, but the ear cells are accurate in determining the correct inclination for the turns. If objects are visible the eyes also assist. With the old "Curtiss" shoulder yokes the instinct to sit upright to the resultant was utilized to operate the ailerons to bank the plane properly. If the turn is a sharp one, as in a "flipper turn," the increased apparent weight is decidedly noticeable. This compares with the conical swing.

Spiraling is a combination of gliding and turning.

Spinning, in its effects, is that of a tight spiral. If the spin lasts for several turns, "persistence" effects may be established, and it was not uncommon, before spinning was practiced, for the inexperienced operator to fail to recognize when the spin had stopped until he was spinning in the reverse direction.

Looping is much the same as swinging high except that the accelerations are still greater, and the apparent weight of the limbs and the head results in confusion as to the force required on the control, and, at first, a distinct sense of annoyance tending to "set" the muscles.

In all the preceding turning evolutions, turns, spirals, spins, and loops, the center about which motion takes place is remote from the passenger, though in tight maneuvers the radius is relatively small. In the "flat spin" the center of rotation is close, and in the barrel roll is probably the closest.

In catapulting and arresting, accelerations of 2g horizontally may be compounded with that of gravitation. In looping, 3g and more; in barrel rolling, 6g; and in pulling out of a sharp dive sharply, 6g may act; in high speed high banked turns, 4g may act.

If acceleration of 4g or more persist for something like four seconds, the vision is affected, resulting in a sort of blindness, but sight is almost instantly restored when the acceleration is released. This has been noted by racing pilots. I am also reliably informed that old pursuit pilots are affected with specks before their eyes on coming sharply out of a steep dive, though younger pilots do not appear to be so affected.

In landing in the daytime the eyes must be accustomed to "anticipation" to judge accurately the distance of rapidly approaching objects. At nightime it is still more difficult, as objects do not assume sufficient distinctness to judge distance accurately until very close.

Flying in fog or clouds or in complete darkness the pilot is almost helpless to determine the attitude or direction of the plane. If the plane flies straight way, the rush of the wind and its direction assists in judging flying speed and the roar of the engine and the singing of the wires also indicate all is well. If the plane slips or skids, the feel of the wind will indicate the direction of same. But an imperceptible turn may start and grow without the pilot knowing whether it is to the right or left, if the plane is properly banked for the turn; if not properly banked, he may detect the skid or slip involved and correct it, but without necessarily regaining level flight; he may even climb or glide to some degree without detecting it from the rush of air or the singing of the wires or the roar of the engine. If the turn becomes steep enough he may sense it from his apparent increased weight, but this does not tell him it is a right or a left hand turn. Ultimately he may recognize that he is spinning by the sharp rush of air, and should the plane turn over he will recognize the inverted condition by coming up against the seat straps.

His ears in such case are almost his only means of recognizing the resultant of centrifugal force and gravitation. He may recognize too steep a climb from the slowing down of the plane and his engine and from the sloppiness of the control action, or he may recognize a glide or sharp dive in the same manner, except that the controls will be smart instead of sloppy in their action.

All of the above indicates the need of instruments in thick weather or at night, and he should have the following:

Air-speed meter, to determine speed above stalling.

Tachometer, to determine proper engine speed.

Turn indicator, to avoid turns or determine their direction.

Turn indicator, to straighten course and make the "inclinometer" or his ears tell the truth as to lateral attitude of plane.

Turn indicator and inclinometer, to insure plane is level laterally and not turning, so the compass will tell the true course.

The inclinometer without the turn indicator is subject to the same errors as the ears.

So far I have dealt with subjective coordination. I think I have said enough to establish the fact that the senses involved are subject to confusing effects. I need only say further that practice and experience alone are effective in enabling a correct interpretation of the sensations experienced. Adequate training and experience and continuity of practice soon bring these to the realm of reflex action.

Now, a few words for the objective coordination required. The control of the plane involves the rudder for direction, the elevator for climbing or gliding, and the ailerons for rolling and the throttle for speed. The rudder is controlled by the feet; pushing forward on the right foot turns the plane to the right, and vice versa; pushing forward on the stick or control column moves the nose of the plane down, or vice versa; and rolling the top of the stick or the wheel to the right rolls the right wing down, and vice versa. These last two are controlled by the hand.

Moving the throttle forward increases the power, and vice versa.

These are the flight controls proper and their motions must be coordinated in all flight maneuvers.

The proportions of motion and their interrelation depend upon the type of plane and the maneuver in which engaged. To describe these coordinations for different maneuvers would involve a textbook on flight principles and would be out of place in this article. Needless to state, however, the proper coordination requires practice until reflex action is attained, and, further, the effects of accelerations encountered introduce confusion until such reflex action is attained.

Finally, let me emphasize again that coordination of observation and operation must both be attained to a high degree before the accuracy of observation and fineness of control essential to flight are mastered. Once these are established the pilot is ready to go on and while engaged in flight employ his powers of observation and operation to a purpose.

To this point I have purposely refrained from reference to other than flight controls, except in the discussion of flight in clouds or fog, etc.

In the plane itself the pilot has a number of things to observe in addition to those mentioned. The air-speed meter, the turn indicator,

and the compass and tachometer are not essential to clear-weather flight in daylight, but they are useful even then. The gasoline gauge, the oil thermometer, the water thermometer, the oil pressure, the time, and the altimeter—all must be noted from time to time. The radiator shutters, the mixture control, the spark advance must be given thought.

The location of switches and fire-extinguisher valve and the gas valves must be indelibly impressed; also the location of safety-belt latch and the parachute ring.

The whereabouts of other planes, the location of a field or the direction of the wind, in case of a forced landing, must be kept in mind. In cross-country work a chart must be used over new territory and the position and directions checked. If in formation or making a landing the throttle must be kept in hand.

Bombing, torpedoing, spotting, scouting, radio, combat—all involve extension of coordination required of the pilot even in planes having more than one in the crew.

Considering the above it is little wonder that the physical requirements and mental requirements of military pilots are so high or that many of those meeting these standards even fail to qualify for flight. To class such pilots as simply aerial chauffeurs is a confession of ignorance.

To select candidates carefully for such work is of greatest importance; to choose successfully such candidates requires an appreciation of the two phases of coordination involved. This can be advanced by the use of improved recording apparatus designed to test coordination of observation and operation and incorporating a feature to indicate the improvement resulting from practice over a short period. In some manner the confusion of impressed accelerations through rotation about a remote center appears as an important requirement of such devices.

THE DIAGNOSIS OF SURGICAL DISEASE OF THE KIDNEY

By G. F. Cottle, Lieutenant Commander, Medical Corps, United States Navy

The diagnosis of disease is seldom an exact science. It often must be a conclusion based upon a group of facts, colored by the experience and ability of the diagnostician. We are told that a careful history and physical examination form the basis of all medical diagnosis and that the findings of the clinical laboratory and the X ray must fit into the clinical picture and be correlated with it before their value is apparent. When we subject these clinical diagnoses to the test of an operation or an autopsy, opinions and conclusions become facts.

What was clinically probable or improbable becomes demonstrated fact, and the tissues seen and removed for section and microscopic study tell the real story.

In the realm of diagnosis, certain organs are relatively silent; that is, they have the ability to give very few symptoms or none at all. The kidney is one of those organs in which disease may lodge and be long unsuspected, because in itself it is capable of producing very few symptoms which directly suggest kidney pathology. The urine of course tells a story, but even if abnormal urinary content is discovered it does not always tell whether the kidney is affected, and it certainly does not tell whether the right, the left, or both kidneys are involved.

Of late years surgical diseases of the kidney have been subjected to certain special methods of examination, which we call urological. The urologist is not content with a history, a physical examination, and routine examination of the urine. He looks inside the bladder, studies its mucosa, looks at the ureteral orifices, catheterizes the ureters, studies the urine from each kidney separately, and then, by means of fluids opaque to the X ray, he obtains a shadow of the ureters and of the kidney pelvis. Because of his work in cystoscopy, ureteral catheterization, and pyelography, we have so sharpened our diagnostic ability that obscure symptoms become clarified and exact diagnoses become possible, where heretofore only suspicion of disease existed.

Surgical diseases of the kidney may be classified as follows:

1. Injuries.
2. Anomalies of form, position, number; horseshoe, floating, absent; polycystic kidney.
3. Hydronephrosis: Congenital; acquired.
4. Infections: Pyelitis, pyelonephritis, perinephritic abscess.
5. Tuberculosis.
6. Stone.
7. Tumor: Malignant; benign.

The symptoms of these conditions are few. They include pain, nycturia, anuria; leucocytes, red blood cells, albumen, bacteria in the urine. The physical signs referable to the kidney are few; tenderness in the costovertebral angle and palpable mass in the kidney region, sometimes elsewhere. How often in taking a history do we forget to ask the patient, "Do you get up at night to pass your water?" And, yet, getting up to urinate two or more times at night may be the only obvious symptom of an early tuberculosis of the kidney, a pyelitis, or a pyelonephritis. How often have we seen a urine reported from the laboratory, "Albumen, plus one, with few leucocytes," without making a thorough search to find whether those

leucocytes are coming from the kidney or not? Of course if a man has fallen from a height and has a sudden appearance of blood in the urine, we immediately think of injury to the kidney. If a man is doubled up with a severe colicky pain which radiates to the testicle, we think of stone. If a man is anemic, cachetic, gives a history of hematuria, and we feel a mass in the kidney region, we think of hypernephroma. If a man has pyuria and bacteriuria, high fever, and a tender loin, we think of pyelonephritis or pyonephrosis. But if a man has pain in the right upper abdomen, or over McBurney's point, with fever and leucocytosis, do we search for tenderness in the costovertebral angle and for leucocytes and bacteria in the urine? Yet we know that pyelitis has not infrequently simulated appendicitis. If a man has a very irritable bladder, urinary frequency, history of hematuria, and tuberculosis in the lungs, we will undoubtedly think of renal tuberculosis, but do we often stain the urinary sediment for tubercle bacilli or have a guinea pig injected when a patient merely has a few leucocytes in the urine and a history of getting up to pass his water at night?

If we become suspicious that kidney pathology may be present we will give more weight to these few symptoms and signs and we will more often ask the urologist to help us out in cases with pain, slight frequency of urination, and a few leucocytes in the urine, and by so doing will more frequently diagnose a surgical condition of the kidney early enough to permit the urologist or the surgeon to institute treatment that will bring about a cure. It is not difficult to collect the urine in a sterile bottle and send it to the laboratory for culture. To stain a smear of the urinary sediment for bacteria or for tubercle bacilli is no more difficult than to stain a smear of the sputum for these organisms.

Pain in the loin, back, or abdomen; tenderness in the costovertebral angle; a palpable kidney; a mass in the abdomen; a few leucocytes or red blood cells or albumen in the urine; a little frequency in urination, especially at night, may be found in a patient who has not a surgical disease of the kidney, but when these symptoms and signs appear, surgical disease of the kidney should be suspected more often than it is. Pyuria and bacteriuria should be sought for by culture and by the staining of urinary sediment more often than is the present custom. The guinea pig should be injected more often when pus appears in the urine without bacteria in the stained smear. An X-ray examination of the kidney, ureters, and bladder should be made more frequently when pain in the back, abdomen, or loin is complained of by a patient.

If we are on the alert to elicit these few symptoms and signs, if we look more often for pyuria and bacteriuria, if we think in terms

of kidney pathology, we will increase the percentage of accuracy in our diagnoses and call more frequently upon the urologist for a special examination of our patients than we do as a routine to-day.

Cystoscopy is not a very trying ordeal for the patient. Ureteral catheterization and pyelography are not a menace to the patient's welfare. These means of bringing the kidney into the lime light are exact and satisfying. A negative cystoscopy and a normal pyelogram are as valuable to the diagnostician who suspects the kidney, as a negative X-ray examination of the lung is to the diagnostician who suspects pulmonary tuberculosis. A positive urological finding may often be of the utmost value to the patient.

It is true that among patients who apply for treatment in the Navy the age is that of appendicitis, rather than hypernephroma, but among young men are a considerable number who have pyelitis. Occasionally there appears a case of hydronephrosis or stone and rarely one of tuberculosis of the kidney. In the naval hospital, which receives patients who are older, the number of cases of surgical disease of the kidney is greater. At the United States Naval Hospital, New York, during a period of two years, there were discovered by the urologist the following conditions:

Anomalies of position:	
Polycystic kidney	4
Hydronephrosis	10
Infections:	
Pyelitis	10
Pyelonephritis	1
Tuberculosis	3
Stone: Kidney and ureter	10

Among the patients there were 22 operated upon as follows: For stone, 8; for hydronephrosis, 10; for tuberculosis of the kidney, 3; for pyelonephritis, 1. All had defied exact diagnosis until they were referred to the urologist for his special examination. In these 22 operations there was one death, an advanced case of tuberculosis. The remainder were cured by operation and these cures were made possible because symptoms and signs were subjected to the keen analysis of the urologist; because the findings of the X ray, of the clinical laboratory, and of the pyelogram were brought together in the mind of the urologist and made to tell not only that pathology was present but on which side is was to be found, and, above all, to tell the condition of the other kidney, so that surgical intervention could be safely undertaken.

SUMMARY

1. Pain, nocturnal frequency of urination, and costovertebral tenderness, either alone or together, should make us suspect surgical disease of the kidney.

2. A count of leucocytes and red blood cells in the urine will often aid the diagnostician when the simple recording of leucocytes and red blood cells without a count will fail to be of assistance.

3. A culture of the urine and staining of the urinary sediment will often reveal a bacteriuria which will not otherwise be suspected.

4. Examination of the urinary sediment for tuberculosis, and guinea-pig injection are as important diagnostic procedures as is the examination of the sputum for tuberculosis.

5. An X-ray picture of the kidney, bladder, and ureters will often reveal a stone which may be the underlying pathology that brings the patient to the doctor.

6. Hematuria is an important symptom and most often means either injury, tuberculosis, stone, or hypernephroma.

7. Operative interference upon the kidney should not be undertaken without the guidance of a complete urological examination.

8. Cystoscopy, pyelography, and ureteral catheterization have brought the diagnosis of surgical kidney out of the realm of uncertainty and doubt into the position of exactness and given a very high percentage of accuracy to diagnoses which formerly were very difficult to make at all.

9. Diagnoses of surgical kidney early enough to be of benefit to our patients will be made when we are ready to suspect the kidney and ready to undertake for them the methods of diagnosis now easily obtainable, wherever a urologist and roentgenologist are to be found.

CLINICAL NOTES

MALIGNANT DISEASE OF THE LUNGS

WITH REPORT OF CASE

By J. D. BLACKWOOD, Jr., Lieutenant, Medical Corps, United States Navy

Among the many diseases affecting the lungs, malignancy, fortunately, is relatively uncommon. Therefore, it may be well to refresh our minds by reviewing some of the salient features as described in the literature.

New growths of the lungs may be primary or secondary.

I. *Primary growths* are rare and are most commonly carcinomatous but may occasionally take the form of endothelioma or sarcoma. They are usually unilateral and affect men more frequently than women. Dissemination may occur along the bronchi or along the vessels and a miliary carcinomatosis may be produced resembling a miliary tuberculosis. Pleural involvement is generally by direct extension.

(*a*) *Carcinoma* may arise from the (1) bronchial epithelium, usually beginning below the bifurcation, with equal frequency on either side, and later invading the parenchyma along the bronchi which may be obstructed by a thickening of their walls or by papillomatous growths followed by cavitation, mostly at the hilus; (2) bronchial glands (the cellular structure of the mucous glands) and is limited chiefly to the walls of the bronchi; or (3) alveolar epithelium, causing a diffuse growth or nodules with final softening and single or multiple cavities. A lobe or a larger area may be rapidly involved.

The cellular structure of these various forms is frequently characteristic of the point of origin, but pleomorphism is often marked.

(*b*) *Sarcoma* is very rare and arises from the metablastic tissue of the lung parenchyma, being either round or spindle celled in type. It usually occurs as discrete nodules, either single or multiple, but may form a single large tumor. Cavitation is not common.

(*c*) *Endothelioma* may arise from the endothelium of the blood vessels, lymphatics, or pleura.

II. *Secondary growths* are more common and may be:

(*a*) *Carcinoma* which has metastasized, from the breast, stomach, intestines, liver, pancreas, prostate, or kidneys. The most common

metastases are from the breast or kidneys. Carcinoma of the stomach may extend directly through the diaphragm to the pleura or lung.

(*b*) *Sarcoma* which is less common than carcinoma but is the result of metastasis in a greater proportion of cases. It occurs as multiple tumors or large infiltrating masses. Bone and melanotic sarcoma almost always results in lung metastases. Metastasis may be from mediastinal growths arising from the lympatic glands, connective tissue, periosteum of sternum or vertebræ, or in the remains of the thymus gland. The majority of these growths are lymphosarcomata but spindle celled or chondrosarcomata may occur.

(*c*) *Chorionephithelioma*, and

(*d*) *Hypernephroma* also produce secondary growths in the lung.

Types

The following types have been described:

I. *Acute galloping pleuropneumonic form*, giving dyspnea, cough, asphyxia, rapid emaciation, and death in 6 to 12 weeks. This form may be primary but is most often secondary to unrecognized disease elsewhere. Cobalt miners are liable to primary carcinoma.

II. *Chronic pleuropulmonary carcinoma.*—

1. Bronchopulmonary form, most typical variety, begins with bronchial symptoms, bloody expectoration, loss of weight and strength, and anemia. Earliest indication is usually about the root of the lung and gives physical signs suggestive of tuberculosis. It may progress to cavity formation. The sputum may be bronchiectatic in type and show very large round cells with fatty granules (degenerated cancer cells) and an absence of tubercle bacilli.

The X-ray picture is not distinctive and is usually diagnosed as tuberculosis.

2. Mediastinal form, with early involvement of the glands and pressure symptoms giving the mediastinal syndrome:

(*a*) Pressure on air passages: Dyspnea, which may be inspiratory or expiratory and paroxysmal; cough, which may be harsh and brassy; and expectoration.

(*b*) Pressure on infiltrated lung: Causing collapse of the lung or an accumulation of pleuritic fluid which is sometimes bloody.

(*c*) Pressure on arteries: On pulmonary, causing local gangrene or fatal hemorrhage; on subclavian, causing unequal radial pulses which may only be present when patient is recumbent.

(*d*) Pressure on veins: Causing distorted or tortuous veins on the chest, abdomen, or neck. The flow of blood in these veins may be reversed due to obstruction of the superior vena cava or its main radicles. There may be edema of the chest wall, face, or neck.

(*e*) Pressure on nerves: On vagus, causing paroxysmal dyspnea and cough; on recurrent laryngeal, causing hoarseness and paralysis or spasm; on the sympathetic, causing dilatation of the pupil, followed later by contriction and drooping of the upper eyelid; on the phrenic, causing paralysis of the diaphragm on one side; on the intercostals, causing pain.

The pain and dyspnea cause the patient to lean forward, thus increasing the anteroposterior diameter of the mediastinum and lessening the tension of the growth.

3. Pleuritic form, which may or may not give pleuritic pain, friction, of fluid formation (usually bloody), cough, and dyspnea. Subcutaneous nodules may occur along the ribs with involvement of the cervical and axillary glands. The chief symptoms may be weakness, emaciation, and anemia.

Diagnosis

The diagnosis of malignant growths in the lungs is not easy. Frequently the condition is diagnosed as tuberculosis, chronic pneumonia, or unresolved pneumonia. Patient may even go to autopsy with the condition unsuspected, as malignant growths, especially sarcomata, may attain quite a large size without producing symptoms.

The early symptoms are slight—malaise, cough, and expectoration, just as in nearly all lung diseases. As the growth progresses and pressure is exerted there may be pain, dyspnea, loss of weight, and a currant jelly character to the expectoration. If the pressure is upon a bronchus, there may develop emphysema or lung collapse, secondary pneumonia, lung abscess, and gangrene. If the bronchus is obstructed but the blood supply remains intact, there may develop a cyanosis out of proportion to the dyspnea, due to the flow of unoxygenated blood through the lung (admixture cyanosis). If the pleura is involved there may or may not be pain and a sudden accumulation of fluid (frequently bloody), which accumulation does not relieve the pain if it is present. Pressure on the mediastinal structure will produce the mediastinal syndrome, previously described. Fever generally occurs, due to secondary infection. Physical examination may or may not be of value depending upon the location and size of the tumor and upon the secondary results of pressure. There may be a restriction of motion of the affected lung out of proportion to the involvement. The chest may show retraction or bulging. Percussion may elicit anything from resonance to flatness, depending upon the location of the tumor and the condition of the surrounding lung tissue and pleura. Auscultation may fail to elicit any breath sounds or may elicit tubular breathing.

Sputum examination may at times show cells with large vesicular nuclei and nucleoli, and vacuoles in the protoplasm, not infrequently arranged in strands or nest. If there has been metastasis of the tumor to some superficial tissues, biopsy may lead to a correct diagnosis.

The X ray may or may not be of value, as frequently malignant disease of the lung is diagnosed as tuberculosis, unresolved pneumonia, lung abscess, localized pleural effusion, or nontuberculous infiltration. In fact, some writers warn against relying upon the X ray to prove or disprove the presence or absence of tumor.

It is recognized that, at present, diagnosis is so difficult that even advanced cases are usually overlooked.

Case Report

A. W. L., A. R., second class, U. S. N. Age, 35 years. Diagnosis undetermined.

Admitted (U. S. Naval Hospital, Washington, D. C.) September 19, 1925, complaining of dyspnea, cough, pains in the chest, and loss of weight during the last two months. About August 1, 1925, he reported to his medical officer, complaining of inability to breath through his nose. Examination revealed a polypus in the right nostril, which was removed at the Naval Dispensary, Washington, D. C. On September 11, 1925, he reported that he could not sleep at night on account of a persistent cough. Examination, at this time, showed a small area of consolidation at the apex of the left lung and râles scattered throughout the chest. Temperature and pulse were very slightly elevated at 4 p. m. each day. Daily examinations of the sputum were negative for tubercle bacilli. Feces was negative for parasites. There was nothing in his medical abstract.

Upon admission, he stated that the pain in his chest and shoulder blades came on with deep breathing or coughing; that the cough was worse at night and was followed by vomiting; that there was no expectoration; that he had dyspnea upon exertion, and that he lacked "pep." There was nothing of note in his history except the above.

Examination

Weight, 132; normal weight, 150.

Eyes.—Palpebral fissures large, and reactions and movements, normal.

Teeth.—Decayed and molars absent.

Throat.—Normal.

Thyroid.—Normal.

Superficial lymph glands.—Normal.

Abdomen.—Normal.

Joints.—Normal.

Genito-urinary system.—Scars on penis, otherwise normal; no hemorrhoids, fissures, or hernia.

Chest.—Deep, alæ bulging, epigastric angle obtuse. Expansion was better on the right.

Heart.—Unable to determine the left border on account of the flatness of the lung area. Apex, fifth i. s.—inside M. C. L. Right border three-fourth inch to right of sternum.

Lungs.—There were no abnormal signs elicited over the right lung. The left lung gave flatness anteriorly, on percussion, from the apex down to the fifth rib and impairment below. The breath sounds over this side were peculiar. There was a bronchial type of breathing over the flat area but it was distant as though the examiner were listening to sounds transmitted through a piece of felt. Vocal resonance over this flat area gave bronchophony of the same distant character. Below the fifth rib anteriorly the vocal resonance was diminished. The only other abnormal physical signs over the left lung were a weak bronchovesicular breathing above the spine of the scapula, a weak quality to the breath sounds elsewhere, posteriorly, a diminished vocal resonance above the spine of the scapula and occasional sonorous râles over the entire left lung posteriorly.

The apices were equal and broad when mapped out by percussion posteriorly. The left base was higher and expanded less than the right.

Conclusion.—Consolidation of the left upper lobe. Lungs otherwise normal. X ray (taken after the physical examination), "Left upper lung is obscured by a gray shadow. The gray shadow is more dense at the apex and there is no sharp line of demarcation at its lower border. The right lung shows some infiltration but of a much softer variety. Conclusion: Probable tubercular pneumonia upper left lobe with early involvement of the right. (s) R. W. H."

NOTE.—This X-ray diagnosis was concurred in by the röntgenologist of one of the leading hospitals in Washington.

Wassermann—(9-21-25)—four plus.

Kahn—(9-21-25)—four plus.

Blood—R. B. C., 4,880,000. W. B. C., 10,500. Hgb., 96. Poly., 75 per cent. Lymp., 21 per cent. L. M. & T., 3 per cent. Eosin., 1 per cent.

Sputum—T. B., negative (15 examinations).

Clinical course: T—96^8 to 100^2 (once); P—72 to 106; R—18 to 24; generally normal, averaged about 88 during 33 days.

In spite of the facts that this patient was on the tuberculosis wards, presenting signs of consolidation of the left upper lung field, and a definite X-ray diagnosis of tuberculous pneumonia of the left upper lobe, with early involvement of the right lung, the peculiar character of the physical findings (as though heard through felt), and the asthmatic character of his attacks of dyspnea, which were both inspiratory and expiratory, caused the writer to doubt that he was dealing with a case of pulmonary tuberculosis. The negative findings for tubercle bacilli in the sputum were only a partial help, as we have seen even advanced cases of pulmonary tuberculosis (proved at autopsy) which failed to show tubercle bacilli in the sputum for a considerable period before death. The patient therefore was given mercury by inunction 10 days after admission and three days later was given K. I., at first 2 grains t. i. d., and then 15 grains t. i. d.

The asthmatic attacks continued and gained in severity in spite of treatment consisting of the above, calcium lactate, gr. x. t. i. d., and adrenalin, m xv, atropin sulphate, and morphine during the attacks. These attacks would last from one-half an hour to several hours, exhausting the patient. During them he would lean forward, sitting up in bed. They were followed by periods of comparative comfort. On October 9, 1925, he spat up long strings of mucus and from then on his asthmatic attacks became more frequent and severe and were uninfluenced by any treatment.

On October 14, 1925 (about two and one-half months after his first complaint to his medical officer), after an asthmatic attack which continued all night in spite of all treatment, he became cyanotic, although his heart action continued

good, with marked expiratory embarrassment. His skin was clammy. At 11.05 a. m. he died.

NOTE.—At no time were there signs of pressure on the superior or inferior venæ cavæ except the cyanosis. The heart was not displaced except for slight enlargement to the right.

AUTOPSY REPORT

October 14, 1925, 1 p. m. The body is that of a poorly developed and nourished, middle-aged, white male. No marks of violence noted on any part of the body. A superficial discoloration is present on left thigh extending from 4 inches above the patella to Poupart's ligament. Rigor mortis not present.

The usual midline incision, extending from the manubrium sterni to the symphisis pubis, was made and the anterior wall of the thorax removed.

Inspection of the abdomen reveals little or no fluid with the liver dark red in color and extending 5 cm. below the costal margin. The peritoneum appears smooth, glistening, and normal in color. The thorax shows a bulging in the mediastinum and a distended pericardium.

The spleen is dark red in color and apparently normal in size. No evidence of pathological changes noted.

The kidneys—right and left—appear normal. They are surrounded by a small amount of perirenal fat. The capsule strips easily, leaving a smooth surface. Cut section shows nothing unusual. The suprarenals and pancreas show no abnormal changes, grossly or on cut sections.

The bladder and prostate appear normal.

The liver is dark red, smooth, and firm. It bleeds easily, cut section showing a smooth, dark red surface. No abnormal changes other than congestion, passive acute, noted. The gall bladder is distended with bile, but contains no calculi.

The stomach and intestines are normal in appearance and show no gross pathological changes.

The pericardium when opened shows no evidence of pathology. It contains about 300 c. c. of clear straw-colored fluid.

Upon removal of the heart, a firm mass of tissue completely surrounding and compressing the great vessels, nerves, and bronchi is found. This mass is white, extremely friable, comes from behind the heart, and extends over into the left lung by direct invasion. The heart is large for the individual. The right auricle, tricuspid valve, and right ventricle show no gross changes. The pulmonary valves appear normal, as well as the left auricle and mitral valve. The left ventricle is definitely hypertrophied, measuring 3 cm. in thickness. The bulbous aorta, aortic cusps, and ascending aorta show numerous atheromatous patches, but no calcification. The left lung is black in color and is adherent to a greatly thickened pleura. It is crepitant and air bearing. It is delivered with extreme difficulty. The pleura shows extensive thickening and infiltration in the region of the apex. At the hilus, the mediastinal mass is adherent to the lung and has grown down into it along the course of the bronchi for about 5 cm. Cut section shows a smooth black surface throughout. In the upper lobe a small irregular cavity 1.5 by 3 cm. is present and filled with a mucopurulent material. Stained smear negative for *B. tuberculosis*. In the center of the lower lobe a firm white solid mass of material 2 by 3 cm. is present. This is similar in character to that found in the mediastinum. Dissection shows it to be connected directly with the mass at the hilus. The right lung is black throughout and loosely adherent to the pleura at the apex. It is

crepitant and air bearing throughout. Cut section shows a smooth, black, moist surface. No cavity formation or other evidence of gross pathological changes noted. It apparently is not involved in the tumor complex.

The tumor, which extends from the episternal notch down to the hilus of the lungs, involves and incarcerates all structures in the upper mediastinum, is now removed. It has apparently caused marked constriction of the bronchi, esophagus, nerves, and great vessels of the heart.

ANATOMICAL DIAGNOSIS

1. Mediastinal tumor, probably a sarcoma involving the lower lobe of left lung by direct extension.
2. Cavity formation of upper lobe of left lung.
3. Anthracosis of both lungs.
4. Extensive fibrous left pleuritis.
5. Hydropericardium.
6. Acute passive congestion of the liver.

CAUSE OF DEATH

Compression of great vessels, nerves, and bronchi of the mediastinum as a result of a rapidly growing neoplasm, probably a sarcoma.

MICROSCOPIC DIAGNOSIS

Connective tissue tumor, malignant, sarcoma.

Sections of the tumor show same to consist of a mass of embryonic, anaplastic, connective tissue cells in a state of rapid division. Nuclear figures in all phases of development are present throughout. Areas of necrosis and round cell infiltration appear in various places. Due to the anaplastic type of cell, it is impossible to state the class of sarcoma; however, it corresponds more closely to the sarcomatoid type of Hodgkin's disease described by Ewing than any other. The tumor certainly is rapidly growing and of a high degree of malignancy. Sections from the wall of this cavity of the upper lobe of the left lung show sarcomatous degeneration with no evidence of tuberculosis.

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SUMMARY

What were the outstanding features in this case?

1. The marked involvement demonstrated by physical examination and by X ray within six weeks after his first symptom could be interpreted as showing either a rapidly progressing disease or one of those cases of sarcoma which grow to large size before producing symptoms.
2. Within two and a half months after his first subjective symptom the patient was dead.
3. The physical signs were elicited anteriorly instead of posteriorly where some authorities state they first appear.
4. The involvement affected the upper lung field instead of the lower.

5. There was an absence of fever, which, it is stated, most cases present.

6. The X ray was of no value in the diagnosis. In fact it was misleading.

7. The most striking physical findings were the marked flatness on percussion and the blanketing of the bronchial breathing and bronchophony over this area as though the sounds were heard through a piece of felt. This was due to the greatly thickened pleura.

8. The most striking symptoms was the paroxysmal dyspnea, at first inspiratory and later both inspiratory and expiratory. Evidently the pressure of the growth was mostly upon the trachea, bronchi, or the vagus, as none of the other symptoms of the mediastinal syndrome were noted.

9. The leaning forward of the patient during these dyspneic attacks was characteristic of mediastinal growths.

10. There was cavitation which is not common in sarcoma.

REFERENCES

1. Strumpell: Text Book of Medicine, Vol. 5.
2. Price: Practice of Medicine.
3. Osler: Principles and Practice of Medicine, 8th edition.
4. Oxford Medicine, Vol. II.
5. Nelson's Loose Leaf Living Medicine:
   (a) Barron, M.: Arch. Surg., 4:624 (1922).
   (b) Cramer and Saloz: Rev. Med. de la Suisse rom., 42:160 (1922).
   (c) Rizer and Habein: Minnesota Med., 5:352 (1922).
   (d) Cramer: Bull. et mem. Soc. d'Hop. de Par., 46:826 (1922).
   (e) Nussbaum: Munchen. Med. Wcknschr., 69:507 (1922).
   (f) Dever and Royce: Penna. Med. Jour., 25:545 (1922).
   (g) Rolland: Bull. et mem. Soc. Med. d'Hop. de Par., 46:939 (1922).
   (h) Thiroloix and Purquin: Bull. et mem. Soc. Med. d'Hop. de Par., 46:1086 (1922).

DIABETIC GANGRENE OF LOWER EXTREMITIES[1]

WITH REPORT OF CASES

By H. D. SCARNEY, Lieutenant (Junior Grade), Medical Corps, United States Navy

In patients with diabetes one notes they are very prone to develop gangrene, wet or dry, carbuncles, abscesses extending down to and including the muscles, and osteomyelitis. The knowledge of such facts allows many to believe that infections, especially of the lower extremities, whether gangrenous or not at the beginning, will ultimately resolve themselves into gangrene, and, in order to avoid the inevitable, amputation is oftentimes carried out too soon. Recogni-

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tion of the variety of lesions that may occur in the lower extremity is of the greatest importance from a standpoint of prognosis and treatment.

Coller and Marsh have made the following classification which has aided them considerably in determining the type of treatment and prognosis in their series of diabetic cases:

Types

1. Ulcer.
2. Infections:
   (1) Soft parts.
   (2) Osteomyelitis.
   (3) Osteomyelitis and secondary gangrene.
3. Gangrene:
   (1) Infected.
   (2) Uninfected.

They have found that conservative treatment of ulcers, infections of soft parts, and osteomyelitis has proved best in their hands; while gangrene, dry or infected, is best treated by radical surgery. When gangrene appears it is a signal for amputation, and the chief reason for amputation is the rapidity with which such lesions drag down the vitality of an elderly person, for they are the ones practically always afflicted. A patient who has a gangrenous extremity loses his appetite, usually because toxic substances are absorbed. The patient thereby becomes emaciated, gets a gradual lowering of his sugar tolerance, and becomes progressively harder to keep sugar free. The power to burn carbohydrate rapidly fails, resulting in incomplete fat combustion and consequent acidosis. The loss of weight and appetite, and decrease in sugar tolerance, was well demonstrated in the cases reported—Case I showing a loss of 14 pounds in a period of 40 days and Case II showing a loss of 25 pounds in a period of 3 months. It is well known that gangrene of the extremities is a fairly frequent complication in diabetes; not that the condition of diabetes itself necessarily gives rise to gangrene, but that in individuals suffering from this malady there is usually to be found an associated generalized arteriosclerosis, which, together with the recognized lowered resistance of the tissues to infection, may be said to prepare the field for those circulatory disturbances of the extremities that eventuate in gangrene. A hyperglycemia of some years' duration has, in some manner, gradually produced an arteriosclerosis that may be of the most advanced degree. The immediate factor in the production of the gangrene is an arteriosclerosis of the usual senile type, but as to the cause of arterial disease we are still quite ignorant.

The question arises, Is there any etiologic relation between the diabetes and the arteriosclerosis? Labbé, of France, has shown

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the cholesterol content of the blood to be high in diabetes, and he has found arterial obliteration due to cholesterol localization in the tunica intima. N. M. Alter has shown that high protein diet plus infection produces arteriosclerosis and by his experiments verified the work of many others to whom he refers in his bibliography. High protein diet plus infection, plus a high cholesterol content of the blood, after the onset of diabetes, is evidence enough for arteriosclerosis, and yet it is pointed out by Joslin and others that the fact that arterial disease is rarely seen in young or middle-aged diabetics is a strong argument against diabetes being a direct causative factor of arteriosclerosis. There are, however, certain facts that point strongly to a causal influence of diabetes on vascular disease.

In the first place, arteriosclerosis is certainly more frequent, and usually of a severer degree, in diabetes than in other persons of the same age. The fact that youthful diabetics rarely show arterial diseases is not necessarily a valid argument against a diabetic etiology of arteriosclerosis.

It is pointed out that syphilis is usually contracted in early life, yet its vascular manifestations do not tend to appear until the fifth decade. The same is true in diabetes, and the extensive arteriosclerosis in Case I is undoubtedly in a great part due to diabetes.

On examination of the arteries in the amputated extremities of Case I all were found to be markedly sclerosed. The pulsation of the *dorsalis pedis* was not obtained and X-ray examination revealed the density of the shadows of the arterial trunks to be as great as the bones of the foot and leg. After amputation, the dissection of arteries verified the röntgenogram findings. The arteries were of a true "pipe-stem" type. The sclerosis, however, was not found to be uniform, and, according to morphology, could be placed in that class which is described by Mönkeberg, the sclerosis assuming the form of rings. Mönkeberg describes this form as being very common in diabetes, and one is led to the belief that diabetes is a very important factor in the production of such arteriosclerosis. In Case II the arteriosclerosis was more uniform, not so extensive, and the röntgenograms were negative, but the gangrene was more extensive because of the period which had elapsed since the patient had received the minor injury of striking his heel against a rocking-chair.

The accompanying photograph shows the extensive sclerosis of the *princeps hallucis* artery, a branch of the *dorsalis pedis*, supplying the large toe which had become gangrenous, the mortifying process being dependent on the extensive arterial disease.

In the presence of gangrene it must be remembered that the underlying vascular disease is extensive and that it is of a severe degree a considerable distance above the level of actual gangrene. This was found to be true in both cases.

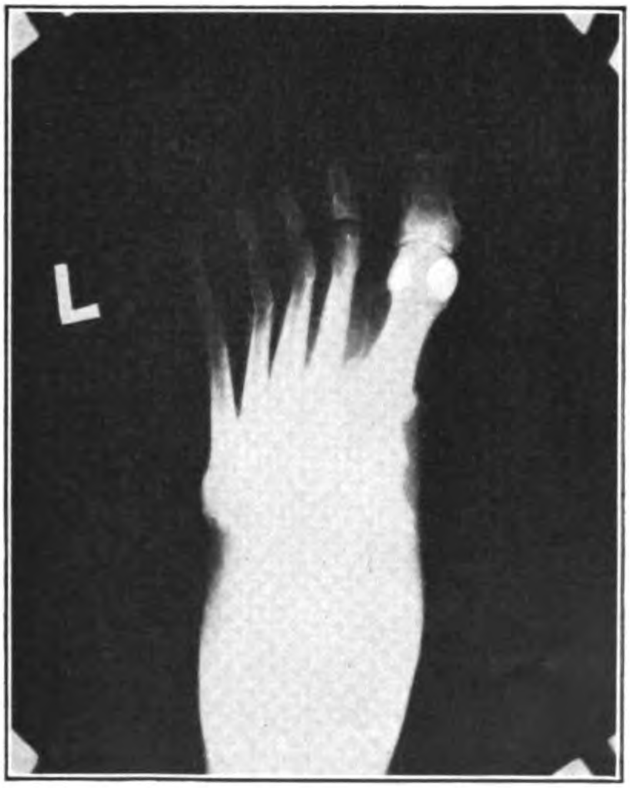

FIG. 1.—SHOWS EXTENSIVE SCLEROSIS OF PRINCEPS HALLUCIS ARTERY

The hazards of surgical operations upon diabetics are undoubtedly greater than the hazards of similar operations on nondiabetics. They are increased still more by cardiorenal and pulmonary diseases, which so often complicate diabetes mellitus and old age.

Up to a few years ago the mortality rate in diabetics with surgical complications and following operations was discouragingly high. In the last few years, however, there has been a decided change for the better. This is well illustrated in a paper published by W. Morris Weeden on the "Mortality of surgical complications in diabetes." He compiled the surgical complications of diabetes that have been treated at the New York Hospital in 25 years from 1897 to 1922, inclusive, and he has added to these the small series of cases in the latter part of 1922 and during the year 1923 which had the advantage of the use of insulin. From 1897 to 1922 there were 160 diabetic patients admitted to the wards; the majority were between 40 and 60 years of age. In the entire series of 160 cases there were 59 deaths, giving a mortality rate of 36.8 per cent. In the 12 patients who had the benefit of operation with insulin there were 2 deaths, giving a mortality of 16.6 per cent.

The best results on record are reported by Wilder and Adams from the Mayo Clinic. Between October 1, 1921, and October 1, 1923, 327 operations were performed on 251 patients with diabetes. The cases were divided into two groups—those treated before insulin was available and those treated subsequent to its introduction. In the 327 operations on 251 patients there were 4 deaths, a mortality from operation of 1.2 per cent. The authors express the opinion that while insulin is a valuable adjunct in the preoperative and postoperative treatment, it can in no way replace good surgery and an intelligent management of each case.

Joslin quotes Morrison, who found gangrene to be a contributory cause of death in 23 per cent of 775 fatal cases of diabetes in Boston during the years 1895 to 1913. The results of the treatment of gangrene in diabetic patients, as regards the duration of life, has varied from 1 to 12 years in Joslin's series of cases. Of the 43 cases treated surgically, 21 are still alive, while 15, or 35 per cent, died during the first year; but of 41 cases treated medically, 17, or 41 per cent, succumbed during the same period. The following statement by Joslin expresses his opinion concerning surgical intervention in gangrene:

> Each year I grow more bold in advising early operation for gangrene. One sees so many patients who are able to enjoy life after the amputation of a limb and hears of so few recoveries with enjoyment of life after months of medical treatment that I can not help urging surgery at an early stage.
>
> If one needs to be convinced of the uselessness of attempting to save most gangrenous legs, the specimens removed at operation should be studied. These

show how hopeless it is to expect the arteries to regain their function. Regret is felt, not for the removal of the leg at the time, but rather that it had not been removed earlier.

The reduction of mortality depends in a large way on the cooperation between the surgeon and internist, skillful surgery, wisdom in the choice of an anesthetic and skill in its administration. The medical part of the treatment should always be entrusted to the internist. If there is no emergency the patient should be made sugar free and fed-up, if necessary, by the aid of insulin to the point where there are some glycogen stores in the tissue, and at the same time he should be fed-up by copious amounts of water by mouth. The dehydration factor in the diabetic should not be lost sight of. According to Joslin, any of the well-recognized systems recommended to get the patient free from sugar and acidosis, such as Allen's method, Newburgh and Marsh, Woodyatt, or his own test and maintenance diets, will suffice. All these diets agree in slightly undernourishing, rather than in slightly overnourishing, the patient, and, as a result, the patient is brought to the operating table with his highest tolerance for carbohydrate, and this means his greatest safeguard against acidosis.

The dosage of insulin given is dependent upon the degree of hyperglycemia and acidosis and upon the amount of sugar and diacetic acid in the urine. Examination of the urine carefully for the quantity of sugar, and to see whether ketones exist in the urine, and their approximate quantities should always be done.

Cases I and II were both made sugar free on the Marsh-Newburgh diet, given copious amounts of liquids, and, before operation, Case II was given 50 grams of glucose with 10 units of insulin. Twenty-four-hour specimens of urine were charted. Before operation both patients were good surgical risks. Before undertaking an operation upon a diabetic patient the surgeon should thoroughly appreciate the dangers with which the patient has to contend and the elements which favor surgical success.

Joslin enumerates four factors which favor surgical success in diabetes:

1. An early diagnosis and an early decision to operate.
2. The adjustment of the diet which has been briefly mentioned above.
3. Insulin as an added safeguard.
4. The choice of an anesthetic.

The selection and administration of the necessary anesthetic should receive very careful consideration. In operations for amputation of gangrenous legs spinal anesthesia is found to be the safest. Its advantages are that it is easily administered, does not cause postoperative vomiting or nausea, and therefore does not cause acidosis.

The choice of the site of the amputation is increasingly in favor of the thigh over the leg, yet the surgeons who have operated on Joslin's cases in recent years have favored amputation below the knee. They have not considered the absence of a palpable pulse in the popliteal space a contraindication to the low site for the amputation.

Case II had the leg amputated above the knee and Case I had the leg amputated below the knee. Examination of the arteries of the amputated extremity in Case I showed an intensive sclerosis as far as the amputation, and I can not help but believe that the stump is an exceedingly vulnerable point for infection, and yet the patient was discharged from the hospital with a stump well healed, and gaining weight.

Case II also showed rapid healing and improvement in appetite and well being. However, at the time of this report there was a beginning discoloration of the large toe of the left lower extremity. It is very important to remember that amputation of the toe is very apt to be followed by a rapidly spreading infection and gangrene of the foot and leg. When primary dry gangrene of a toe becomes infected and gangrene begins to spread rapidly and assumes the moist form, with swelling and redness of the foot and leg, with marked lymphangitis and lymphadenitis, and the symptoms of a fulminating septicemia, the condition assumes a very grave aspect and immediate amputation through the lower third of the thigh becomes imperative and offers the best chance for recovery.

In conclusion, a word should be said concerning prophylaxis in diabetic patients. The elderly diabetic should be told to take regular exercise, preferably walking, to promote circulation in the legs and feet. They should pay particular attention to the cleanliness of the skin and the use of hot foot-baths is to be advised. They should be warned of the potential dangers of trifling injuries, such as a corn or toenail cut to the point of bleeding, or a blister from a tight shoe, and they should be urged to report promptly for treatment when such an injury occurs.

Case Reports

CASE I

January 2, 1926, Veterans' Bureau patient admitted for treatment of infected foot and diabetes.

Chief complaint.—"Feet burn, pain, and get numb"; cold all the time"; "diabetes."

Present illness.—In December, 1924, patient went to Walter Reed Hospital because he had a sore on the inside of his mouth on the left side. While at the hospital he was told he also had diabetes. Before his entrance he had a tremedous thirst; drinking 8 and 9 quarts of water a day. He then noticed

he had frequency of urination; during the day, every hour, and at night, three to four times. His appetite was very good, nothing ever giving him indigestion. He was treated at the Walter Reed Hospital from December 31, 1924, to July 13, 1925. He was put on a diet and given insulin, "45 units." He continued to receive insulin from December 31, 1924, until July 13, 1925. Since July he has not received any insulin and he has not been on a strict diet. Has been at home eating regular meals. States that his thirst has increased since he has not taken insulin but he has not any frequency of urination or nocturia. His appetite is good. He has a burning sensation in his feet which has been especially severe in the last six months. "They pain more when resting after a walk." During the last two weeks the large toe of the left foot began to swell and he noticed nail was growing in, and later pus appeared. The eroded portion is not so painful as the unaffected side of the toe. He thinks the condition of the toe is gradually getting worse. Patient states that his feet have been very cold for four to five months and at present they are hot and "feel as though they are burning up."

Past history.—Usual childhood diseases; no diphtheria, typhoid or scarlet fever; no history of other diseases; no accidents or injuries; operated upon at the Walter Reed Hospital for "cancer of cheek." Denies any venereal infection.

Cardiorespiratory.—States he has been slightly short of breath during the last year; noticed especially when climbing stairs or on the slightest exertion; has no cough, sweats, or hemoptysis; no swelling of extremities.

Gastro-intestinal.—Appetite has always been good; bowels do not move regularly; takes cathartics every other day; never has been jaundiced. No history of vomiting, blood in stools, or hemorrhoids; no history of jaundice.

Genito-urinary.—Had frequency before he took insulin. At present he has no nocturia and urinates three or four times per day. No history of hematuria or dysuria.

Neuromuscular.—Has had dizzy spells and ringing in ears; has never fainted. Numbness and tingling in fingers and toes; has sharp pains in muscles of legs and thighs.

Marital history.—Wife living and well, three girls all living and well. Wife has had no miscarriages.

Family history.—Father 83, living and well; mother dead—stroke; no brothers or sisters; no history of tuberculosis, cancer, diabetes, nephritis, or insanity.

Weight.—Has lost 40 pounds weight in last six years. Present weight, 155 pounds.

Physical examination

General.—Old, adult male, very cooperative, well developed and nourished and not acutely ill.

Head.—Negative. Hair—scant, gray.

Eyes.—Pupils round and equal, react to light and in accommodation. No extraocular palsies. Conjunctivæ and scleræ negative. Fundus examination negative.

Nose.—Negative.

Ears.—No discharge, tophi or mastoid tenderness.

Neck.—No glandular enlargements, pulsations, or tracheal tug. Thyroid gland not palpable.

Thorax.—Large, symmetrical, and of equal expansion. No visible pulsations or tumors.

Lungs.—Resonant throughout, voice and breath sounds slightly increased over right back. No areas of dullness or flatness. No râles.

Mouth.—Mucous membranes of good color. Two small polypoid masses on inner surface of left cheek. Small grayish white areas on buccal mucosa at corners of mouth. Tongue attached to floor of mouth. Tonsils submerged—negative.

Heart.—S. O. D., 5.25 cm. M. R., 3.75 cm. M. L., 9 cm. Heart not enlarged to percussion. Apex beat visible and palpable in the fifth interspace at nipple line. Heart sounds strong, regular, and of good quality. No murmurs. B. P., 120/66.

Abdomen.—Symmetrical, very pendulous, many atrophic areas on skin shows evidence of excessive stretching at one time. No tumor masses. Liver, spleen, and kidneys not palpable. No costovertebral tenderness.

Genitalia.—Negative. Anus negative.

Extremities.—Upper—Muscles atonic, both brachial arteries are palpable. Biceps and triceps are prompt and equal. Lower extremities—Trophic disturbance of second toe on right foot. Toes are somewhat cold and reddened. The large toe on the right foot is swollen and red and not especially warm. On the medial surface of the large left toe there is an ulcer showing an exudation of pus and marked discoloration of the surrounding tissues. Nail loose. On palpation there is no pulsation of the *dorsalis pedis* artery. Knee jerk and Achilles reflexes sluggish on right side after reinforcement. Knee jerks and Achilles not obtained on the left side. Romberg negative.

CASE II

Chief complaint.—"Black sores on the right lower extremity which patient thinks is gangrene. Excessive thirst, some frequency, and loss of weight. Pain in region of sores on leg."

Present illness.—About 10 years ago patient noticed excessive thirst and appetite, frequent voiding of large quantities of urine, and he felt languid and out of sorts. He visited a physician who informed him that he had sugar in his urine. He has been on a diabetic diet since and has been working as a crossing tender up to seven weeks ago. Last summer he bumped his right heel against a chair. It remained sore for a long while. About six months later he noticed a little white spot at the site of the injury. The injured area gradually turned black and slowly became larger. His whole foot felt dead and he consulted his doctor who applied heat and kept the foot clean. The entire heel then began to become dark in color. About a week later a small red spot appeared on the lateral aspect of the little toe, which later also turned black in color. Next the skin over the external malleolus and then the great toe became involved. He discontinued work about seven weeks ago because his leg felt dead. He was not on a strict diet but was eating most anything he wanted but keeping his carbohydrate intake low. He was able to remain sugar free on this routine. He states he lost considerable tolerance when his gangrene developed.

Past history.—Unimportant.

Family history.—Unimportant.

Physical examination

General.—Patient is an adult male, slightly underdeveloped and undernourished, and unable to walk due to lesions on right leg.

Head.—Hair scanty, scalp negative. No sinus or mastoid tenderness. No facial paralysis.

Nose and ears.—Negative.

Eyes.—Pupils round and equal, react to light and in accommodation. No extraocular palsies. Scleræ and conjunctivæ negative.

Mouth.—Mucous membranes negative. Teeth absent. Tongue slightly coated. Tonsils negative.

Neck.—Negative.

Thorax.—Symmetrical, expansion fair and equal.

Lungs.—Negative to percussion and auscultation.

Heart.—Not enlarged to percussion. S. C. D., 4 cm., left border 8 cm. from M. S. L. P. M. I. in fifth interspace within midclavicular line. Sounds strong, regular, and of good quality. No murmurs. A_2 louder than P_2.

Abdomen.—Soft, flat, and tympanitic. No scars or tenderness. Spleen, liver, and kidneys not felt.

Genitalia.—Negative.

Extremities.—On the right foot there are areas of dry gangrene about the heel, internal and external malleoli, and the small and large toes. The skin from the knee down shows reddened areas due to impaired circulation. *Dorsal pedis* palpable on the right and just barely felt on the left. Vessel walls moderately sclerosed. Left leg negative. Reflexes normal.

BIBLIOGRAPHY

1. Caller, F. A. and Marsh, P. L.: Lesions of extremities associated with diabetes mellitus, J. A. M. A., 85:168–171 (July 18), 1925.
2. Roth, H.: Surgical operations on diabetic patients, Am. J. Surg., 39:295–300 (Dec.), 1925.
3. Labbé, M.: Cholesterolemia in diabetics with arteritis, J. A. M. A. (*abs.*), 85:1259 (Oct. 17), 1925.
4. Christie, C. D.: Management of surgical complications in diabetes mellitus, Ohio State Med. J., 20:756–759 (Dec.), 1924.
5. Kern, R. A.: Influence of infection on carbohydrate tolerance in diabetes mellitus, M. Clinics N. America, 6:1053–1066 (Jan.), 1923.
6. Alter, N. M.: High protein diet and intestinal infection as etiological factors in arteriosclerosis, Colorado Med. J., 22:199–204 (June), 1925.
7. Bernheim, B. M.: Impending and real gangrene associated with diabetes; correlation of medical and surgical effort, Am. J. M. Sc., 163:625–634 (May), 1922.
8. Weeden, W. M.: Mortality of surgical complications in diabetes, J. A. M. A., 82:1165–1166 (Apr. 12), 1924.
9. Wilder, R. M. and Adams, S. F.: Present status of diabetic patient as a surgical risk, Wisconsin M. J., 22:557–561 (May), 1924.
10. Joslin, E. P.: The Treatment of Diabetes Mellitus, Lea & Febiger, Philadelphia.
11. MacCallum, W. G.: Textbook of Pathology, W. B. Saunders Co., Philadelphia.

THROMBO-ANGIITIS OBLITERANS [1]

Report of Case

By D. L. Beers, Lieutenant (Junior Grade), Medical Corps, United States Navy

An Irish-American, 42 years of age, entered the Chelsea Naval Hospital in December, 1923, complaining of pain of intense severity in the feet. He dates the beginning of his difficulty to March, 1921, at which time he observed a

[1] From U. S. Naval Hospital, Chelsea, Mass.

hard lump on each thigh just above the knee. This condition was diagnosed as phlebitis and the lumps became softened on the application of ichthyol dressings. Almost simultaneously he began to have frequent recurrences of swollen feet, accompanied by a purplish discoloration which disappeared on elevation of the lower extremities. His feet became numb even when walking a relatively short distance, and on resting and lifting them from the ground he could "feel hot blood rush in." In the summer of 1923 the pain became excruciating and almost continuous, but aggravated by walking and alleviated somewhat on his lying down. Subjectively, the involvement seemed to extend almost to the knee and exposure to cold apparently made it worse. In fact, according to his statement, air of any temperature increased his discomfort and he kept his feet bandaged for that reason. In regard to color changes, a redness appeared first. Later this would deepen and become a bluish purple. In October of the same year he noticed the appearance of an ulcer near the nail of the great toe of the left foot. This was followed by similar lesions between the other toes and a tendency for the ulceration to spread over the entire foot. In the right foot the process was active but no ulceration occurred, and it was at least temporarily arrested by diathermic treatment which stimulated the establishment of adequate collateral circulation.

A general physical examination at the time of entrance into the hospital was negative save for the lower extremities. In the right foot no pulsations were felt, yet there seemed to be nothing grossly abnormal in that member. No pulsations in the left foot were elicited and moist ulcerations were visible on the great toe and at the bases of the others, together with a marked congestion and edema. On December 12, 1923, his left leg was amputated 6½ inches below the knee by the lateral flap method, but the anticipated relief was not afforded and in the course of the ensuing two years exploratory operations, two in number, were performed. In November, 1925, matted obliterated veins were excised from the stump through an incision extending to within a short distance from the inguinal region.

The foregoing discussion was confined to the lower extremities, but his hands and arms were by no means free from manifestations, no doubt a part of the same malady affecting the feet. In the spring of 1923 there developed a soreness with pain and swelling in the palm of the right hand. However, there was no color alteration, and in this feature it differed considerably from the condition of the feet. The pain became more severe, and with the increase in pain was a gradual spreading of the involved area which did not cease until it went above the elbow. The hand and arm symptoms were also aggravated by use. In 1924 a 4-inch section of a vein was excised, but this was found to have been insufficient and another similar operation was performed. At present the arm still gives the patient some discomfort, which is brought out especially on using crutches.

Thus far in his hospitalization six urinalyses have been done, four being negative and two showing a slight albuminuria. One blood count was made which revealed nothing significant—hemoglobin 90 per cent; red blood cells 5,620,000; of the white cells, 68 per cent were polymorphonuclears; 1 per cent eosinophiles; and 31 per cent lymphocytes. No parasites were found in the feces. The Noguchi reaction was negative. An examination of the excised vein showed the following: "Complete obliteration of lumen—evidently old thrombus. Shows canalization."

The etiology of thrombo-angiitis obliterans is not as yet established definitely in so far as the isolation of a specific organism is

concerned, but certain predispositions are found to be fairly constant. The disease is described as being confined almost entirely to male Jews between the ages of 30 and 50 years. That fact lends interest to the case under discussion, and the overemphasis of the racial preponderance in association with this disease undoubtedly contributed to the erroneous early diagnosis of Raynaud's syndrome being made when our patient's first symptoms became evident. Buerger investigated this disease comprehensively and the first 100 cases which came under his observation were male Jews between the age limits above stated, which demonstrated the ease with which this condition may be overlooked when dealing with an individual not of the Hebrew race. Excessive cigarette smoking is claimed by some to have a strong influence in its development, and this is borne out by the percentage of those using tobacco who have this disease. However, it has not as yet been proved a direct cause, but it can not be denied that it is a predisposing factor, in that it perhaps causes alterations in the blood vessels which render them liable to the process. "In thrombo-angiitis obliterans, when migrating phlebitis occurs, certain specific architectural changes can regularly be diagnosticated and found under the microscope." At certain times purulent foci may make their appearance, which at once suggests the possibility of a microbial agent or an infectious causative factor being responsible. In many cases a polycythemia in the neighborhood of 7,000,000 red blood cells with an increase of blood platelets to correspond has been observed, but this is not constant enough to warrant holding the blood stream primarily responsible. A glycophilia at times makes its appearance and Meyer alleges that control of that abnormality lessens the severity of the symptoms.

The pathology of thrombo-angiitis obliterans is not merely an endarteritis, but an acute inflammatory process of all of the vascular coats of the deeper arteries and veins, which leads to a thrombosis, which in turn becomes organized and canalized. There is also a tendency for an accompanying periarteritis which may bind together the regional veins, arteries, and nerves. An inflammation of the superficial veins is usually present, which is given the descriptive term, migrating phlebitis, and may occur without any involvement of the deeper vessels. The site of election is in the peripheral vessels of the leg, although the upper extremities are frequently involved and the process tends to progress proximally, thereby, in certain rare instances, even affecting the iliac vessels. On gross examination there is seen an extensive obliteration in the larger arteries and veins with the appearance depending largely upon the duration of the pathological condition. The vessel is filled with a grayish or yellowish mass which appears pierced by a minute orifice from

which blood may be squeezed. The vessel wall is usually contracted, which gives the appearance of abnormal thickening, but arteriosclerosis is rarely pronounced except in the long-standing cases in which it is merely an incidental occurrence. The microscopical picture is likewise dependent on the stage the disease has reached in the particular vessel under scrutiny. Early there may be seen an acute inflammatory lesion with occlusive thrombosis. Later, miliary giant cells foci form, which are followed by organization and canalization of the clot. Then the inflammatory products disappear and fibrotic tissue develops in the adventitia constituting the periarteritis previously referred to.

The forms of onset are quite variable in this disease and there are fairly well-defined groups under which cases may be catalogued in regard to the clinical picture. It may begin as an intermittent claudication, which is characterized by pain, tension, paresthesia, and weakness which may be so severe as to prevent walking, but will disappear entirely when the limb is put at rest. Color changes and trophic disorders are often present to complicate the syndrome, and these also are subject to individual variation. Then there is an acute onset with the condition being ushered in by symptoms referable to disturbances in the deep vessels. Thus there is severe pain in the calves of the legs, coming on suddenly with no definitely demonstrable cause, which is a manifestation of an inflammatory process in the deep vessels and is followed by a stage of intermittent claudication, which is an indication of circulatory deficiency. In some patients the onset may be overlooked and the physician's attention will first be directed to trophic lesions such as ulcers or even gangrene. In others an apprehension may be aroused as a result of coldness and cyanosis without any concomitant discomfort, which emphasizes the importance of searching for signs of which the patient may not be cognizant. In still others, rheumatic pain in an extremity may be the forerunner of serious localized circulatory failure, and a person, especially a male Hebrew, who complains of any foot discomfort should be given the benefit of a thorough investigation as to the integrity of his vascular system.

A thrombophlebitis, or "migrating phlebitis," is very frequently present in thrombo-angiitis obliterans and occurs, as a rule, before symptoms are present which indicate further circulatory damage. This is an involvement of superficial veins, and such a condition regardless of its severity calls for a guarded prognosis. Certain peculiar cutaneous nodosities are characteristic manifestations in many cases, and the process causing them is independent of varicosities, infections, or trophic disorders in the territories which they drain.

The advent of coldness is influenced by a number of different factors, such as exposure to low temperature, walking, and sometimes even emotional strain, but it is usually accompanied by certain color changes which are brought to the patient's knowledge. However, this symptom is not of the same import to the patient as is the excruciating pain which renders walking almost impossible, but it forms an integral part of the intermittent claudication which is practically an invariable part of the disease.

The objective signs discerned on examination are varying combinations of edema, ischemia, cyanosis, absence of arterial pulsations, and trophic disturbances. The puffiness and the obliteration of surface irregularities can not be entirely blamed on edema, which is confirmed by the absence of pitting on pressure. A proliferative process in the subcutaneous tissue is accountable for the swollen aspect to some extent, yet phlegmonous phenomena do contribute to it and tend to initiate a vicious circle by further hampering the circulation.

The ischemia present is of two types, namely, the mechanical or hydrostatic and the vasomotor. The former depends for its existence on the position of the limb and its observation affords the examiner valuable guides in ascertaining the severity of the disease. On elevation of the member particular attention should be paid to the situation of the blanching, the angle of elevation producing it, the time interval of its appearance, its extent, and any obstinate areas of pallor. Extraordinary blanching of one toe, with chronic cyanosis in the pendant position, is an omen for the development of gangrene.

Cyanosis is decidedly influenced by cold, and when it is constantly present with the limb in the dependent position it may give way to an ischemia on elevation, but patches of it tend to remain. Chronic cyanosis, when an accompaniment of edema, coldness, and localized anesthesia augurs that gangrene is imminent, and amputation at this stage shows extensive occlusion.

When the foot is the site of the disturbance the absence of pulse in the dorsalis pedis and posterior tibial arteries is expected. The symptoms may be absent or slight, with obturation of all of the accessible vessels of the lower extremities and, conversely, the presence of pulses does not preclude the existence of thrombo-angiitis obliterans in the presence of other characteristic signs and symptoms. The severity of the symptoms does not always correspond to the degree of occlusion, due to the collateral circulation which is possible, and the state of the collateral paths plays just as important a rôle in the symptomatology as the quantitative circulatory impediment.

The laboratory findings are not significant in this disease since they are not constant in every case, and no definite abnormalities can be elicited through any tests by chemicals. As previously alluded to.

the blood examination may show an increase in the number of red blood cells and frequently a glycophilia is observed. At the present time, work is being done on injection of the veins with a dye which is impervious to X-ray irradiation, and by following this procedure with a film any solution of continuity of the lumen is demonstrable.

The diagnosis clinically must depend upon the following: Racial predilection, early involvement of the lower extremities, early symptoms of pain or of intermittent claudication, presence of migrating phlebitis, pulseless vessels, blanching of the extremity in an elevated position, rubor and cyanosis when dependent, absence of simultaneous symmetrical involvement, and a slow progressive chronic course terminating in gangrene. Raynaud's disease occurs more often in females and tends toward symmetry of involvement. It is also characterized by stages of syncope and local asphyxia which precede the development of gangrene. Then, too, the pain is unaffected by position of the limb and, as a rule, is paroxysmal in character. Erythromelalgia is asymmetrical as is Buerger's disease, but the pulses do not disappear, the pain is relieved by low temperatures, and gangrene is very rare.

The prognosis varies greatly in different individuals, but should always be guarded, since recurrence in other parts of the body at a later period is extremely common, and the methods of treatment thus far advocated are not sufficiently efficacious to warrant an optimistic outlook.

The treatment of this condition should wherever possible be of a conservative nature and directed toward relief of the sypmtoms. Nothing, either surgically or medically, has definitely cured the disease, but rest in bed for a protracted period of time will often bring relief. In addition to confinement to bed, enhancement of the circulation by heat, prevention of trauma, and treatment of local conditions are found beneficial.

Meyer advocates administration of Ringer's solution where the viscicosity of the blood is increased, and a diet low in carbohydrates in cases having a glycophilia. In some cases the pain is persistently so severe that surgical intervention becomes necessary, and the procedure attaining the best results is radical amputation. Ligation of the femoral vein is only partially successful, and arteriovenous anastomosis will not improve the circulation, as is obvious from the pathology.

BIBLIOGRAPHY

Buerger: Circulatory Disturbances of the Extremities.
French: Index of Differential Diagnosis.
Nelson: Loose Leaf Living Medicine.
McCrae: Osler's Principles and Practice of Medicine.

DYSCHROMATOPSIA IN AVIATION EXAMINATIONS

WITH REPORT OF CASE

By G. M. CONSTANS, Lieutenant, Medical Corps—F, United States Naval Reserve

In the routine examination of eye patients, or in the examination of applicants for naval aviation, color blindness is not an uncommon finding.

A convenient classification of color blindness is one which places in one group the so-called total color blind, and into the other the red-green color blind. Ishihara further subdivides these two groups as follows:

- Congenital color blindness
  - Total color blindness
    - Complete
    - Incomplete
  - Red-green blindness
    - Red blindness
      - Complete
      - Incomplete
    - Green blindness
      - Complete
      - Incomplete

This furnishes a good working basis for the classification of such defects. Congenitally color blind persons may also have other visual defects such as lowered visual acuity. As is noted by De Schweinitz, Chace, and others there is also an acquired type, to which may be applied the above classification, but persons in this group have other ocular defects which bar them from aviation service.

The red-green color blind, known as Daltonites, are more numerous than the totally color blind. Tscherning places this group at about 4 per cent. Five per cent of the males in Ishihara's series were red-green color blind. Three per cent of males and two-tenths per cent of females in Schiotz series (as quoted by De Schweinitz) were red-green color blind. The average seems to be between 3 and 5 per cent.

Of the two types of color blindness, Achromotopsia, or the absence of the power to perceive colors may be readily noted, while Dyschromatopsia, or difficulty in distinguishing colors, it is not always so readily perceived.

Many and varied tests have been devised for detecting color blindness. The Holmgren yarn test formerly widely used in the service is well known. However, as Fuchs notes, this is often unsatisfactory as many of the color blind can pass this test satisfactorily. Chace, in his recent article, states that this test is only 50 per cent efficient, as is shown by the statistics from England and Germany. since it will not detect red-green scotoma or color ignorance. The Jenning's test now used in the Navy is much more satisfactory.

This test was brought into use in the examination of aviators during the World War and proved very satisfactory, according to De Schweinitz. Other tests used are Thompson's lantern test, turning wheel chart tests (Merrill and Oakes), and the various types of pseudoisochromatic charts of Stilling, Ishihara, Nagel, and Green.

Of these the charts of Stilling and Ishihara are the most accurate. Of the two, I believe with Clark, that the Ishihara chart test is the more accurate and simple. In Stilling's charts there are a large number of plates which are unnecessary and confusing, while the key appended to them is altogether too brief. There are only a few plates in the Stilling test that are practicable. The others are misleading, for, as Tscherning states, "there are daltonites who can read these plates of Stilling, while there are persons with normal eyes who are unable to read them." The Ishihara charts, on the other hand, are ingeniously made and very simple, the results are accurate and not confusing either to the examiner or to the applicant. On the first chart there are two digits in red dots on a blue background which are correctly recognized by both the normal and the color blind. The other charts are so constructed that the normals read the digits correctly, while the red-green color blind interpret the digits incorrectly. The total color blind are only able to recognize the digits on the first chart. The basic principle of the Ishihara chart is that the red-green color blind see only the yellow and blue of the spectrum, while they often mistake the red and green, the amount of error being greater or less as the applicant is completely or incompletely red-green color blind.

The following case showed several interesting features. The applicant passed the Jenning's color test repeatedly, twice at Minneapolis under the supervision of the board of which I was a member and also before other boards. He subsequently became a qualified pilot. On his reexamination for confirmation for a commission, during a refraction, he was asked to read the letters above the red line on the Snellen test chart. He proceeded to read the letters above the green line. This fact aroused my suspicion and I immediately tested his color vision with the Ishihara book. This test showed that he was red-green color blind. At this time he was again able to pass the Jenning's test. Upon a later examination before the board we found him able to pass both the Jenning's and Holmgren yarn tests, but to be red-green color blind according to the Stilling's test. Previously these charts had not been supplied. He professed no former knowledge of his color defect nor did he give any family history of color blindness. To convince him of this defect, three other applicants read the Ishihara charts correctly in his presence.

Case Report

C. V. L., S. 2c. (V–5) U. S. N. R., aged 21 years 7 months. A complete physical examination for aviation was negative, and he passed with an excellent grade. All special examinations were negative. Vision was 20/20 in both eyes. Under cycloplegia his true error was S.+1.25 in both eyes and with a S.+75 he could read 20/20 with each eye readily. Depth perception was

10 mm. With the Maddox rod test at 6 m. he had an exophoria of 1 D and right hypherphoria of 0.25 D. At 33 cm. an exophoria of 7 D. The associated parallel movements were normal and there was a prism divergence of 6 D. The external eye condition was normal and there was no spontaneous nystagmus. The accommodation was 12 D in both eyes and the angle of convergence 58°. The perimetric fields were normal for form and colors. The fundi were negative.

His central color vision, using Jenning's test and Holmgren skein yarns, was normal. He was examined at Minneapolis on the 24th of May, 1924, and the 24th of April, 1925, and passed by the board of aviation examiners. He was examined by aviation boards before and after flying at Great Lakes, Ill., on July 1, 1924; July 30, 1924; August 15, 1924; September 1, 1924; June 12, 1925; July 15, 1925. He was again examined at the naval air station at Hampton Roads, Va., July 31, 1925, and found qualified as a pilot. He was trained there and flew successfully as such. On October 25, 1925, when he was examined for a commission as ensign, the examination revealed to me a red-green color blindness as above reported.

This case is not reported to show lack of skill in examination, but rather to point out a mistake which may occasionally occur, where the naval medical regulations are followed out correctly. The important fact to be noted is that an applicant may successfully pass the Jenning's test or Holmgren yarn test and still be red-green color blind.

SUMMARY

The applicant successfully passed at least seven tests for color blindness. In three of these, and presumably in the others, the Jenning's test was used and in one the Holmgren yarn test. He qualified and flew as a successful pilot. There was nothing in his history or revealed by repeated examinations to indicate that he was red-green color blind. This fact was ascertained during a refraction when the applicant read the letters above the green line when asked to read the letters above the red line. This aroused my suspicions and then the Ishihara charts were used and red-green color blindness was found. Subsequently, he again passed the Jenning's and Holmgren yarn tests but was typical red-green color blind with the Stilling and Ishihara tests.

This man was trained for two consecutive years for aviation and maintained a high grade. During this period the Government was put to considerable expense as to pay, material, and instruction for him. He was able to pass the tests for color blindness (following the directions) as noted in the Manual of the Medical Department of the United States Navy, reprint of chapter 11, page 139, No. 1582, using the Jenning's self-recording test for color blindness. In the Manual it is also noted that in doubtful cases the color vision should be checked with test skeins or Ishihara book if available. He was checked with test skeins and passed satisfactorily. No Ishi-

hara book was available at the first examination, but at this time there was no reason to believe from the history or tests that he was color blind.

CONCLUSIONS

1. The Jenning's test or the Holmgren skein tests do not reveal all cases of color blindness.
2. The Stilling and Ishihara tests are apparently more accurate in detecting color blindness.
3. The Ishihara test book is preferable to the Stilling test, in that it is more compact, and less confusing to both the applicant and the examiner.
4. The Ishihara test book should be supplied by the Government to all medical boards examining applicants for aviation.

BIBLIOGRAPHY

1. Clark, Janet: Amer. Jour. of Physiologic Optics, 1924, 5:3, pp. 269–276.
2. Chace, A. E.: Color blindness in industry, Sec. of Opthal., A. M. A., 1926, Presectional volume, pp. 355–363.
3. Edridge-Green, F. W.: The physiology of vision, 1920, G. Bell & Sons (Ltd.), London, pp. 147–273.
4. Fuchs, E.: Textbook of Ophthalmology, 1923, J. B. Lippincott Co., Philadelphia and London, pp. 242–247.
5. Ishihara, Prof. Dr. S.: Tests for Color Blindness, E. B. Meyrowitz Co. (Inc.), New York, pp. 1–6 and plates.
6. Merrill, H. G., and Oaks, L. W.: Am. J. of Opthal., 1926, 9; pp. 38–40.
7. Reprint, Chapter 11, Manual of Medical Department, United States Navy, 1924, Government Printing Office, Washington, D. C., p. 139.
8. De Schweinitz, G. E.: Diseases of the Eye, 1924, W. B. Sanders Co., Philadelphia and London, pp. 72–74, 572–574.
9. Schiotz, J.: Quoted by Fuchs, E., Ref. 4, p. 244.
10. Schiotz, J.: Quoted by De Schweinitz, Ref. 6, p. 572.
11. Stilling Pseudo-Isochromatic Plates for Testing Color Sense, Prof. Dr. E. Hertel, 1922, E. B. Meyrowitz Co. (Inc.), New York, pp. 3–4 and plates.
12. Tscherning, M.: Physiologic Optics, 1924, Keystone Publishing Co., Philadelphia, pp. 317–332.

MULTIPLE CALCULI—STENSON'S DUCT AND PAROTID GLAND[1]

WITH REPORT OF CASE

By F. M. Townsend, Lieutenant (Junior Grade), Medical Corps, United States Navy

Salivary calculi occur frequently enough to be of clinical importance. In going over the literature on this subject considerable can be found on salivary calculi, but it seems that parotid calculi per se are exceedingly rare. In comparison with calculi elsewhere in

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the body, salivary calculi as a whole, are somewhat rare. The salivary glands and their ducts are affected in approximately the following order:

	Per cent
Wharton's duct and submaxillary gland	61.4
Stenson's duct and parotid gland	20.4
Sublingual gland and ducts	18.2

The etiology is not very clear. The calculi are composed, mainly, of the inorganic salts found in saliva, especially calcium carbonate and calcium phosphate. As in the case of tartar on the teeth, these salts are deposited, for the most part, by the action of bacteria. Furthermore, clumps of bacteria or particles of tartar may form the starting point of the calculi, around which salts are deposited.

The total amount of saliva excreted in 24 hours has been estimated at 1,500 c. c. Allowing one-half of this for the parotid glands, the gland on one side would secrete approximately 375 c. c. in 24 hours, or, roughly, about 15 c. c. every hour. This is quite a stream and any interference with its flow is liable to cause trouble. In one case, that of a student, the attending surgeon thought the predisposing cause to have been the habit of resting the left cheek on the left hand while studying, thus causing stasis in the duct. This is especially true of pressure on the duct where it turns around the anterior border of the masseter muscle and dips down to the mucous membrane. This causes stasis in the salivary flow and also traumatizes the duct itself, making more likely a deposit of salts of saliva, forming calculi.

Concretions are found most frequently in middle life, and among men, more often than women, although children occasionally are affected and a congenital case has been reported by Bardel.

A small particle of calculus from about the neck of the teeth may find entrance into the duct of the gland and act as a foreign body or become the nucleus for the formation of a salivary stone. The presence of masses of bacteria in the center of concretions of lime salts, however, demonstrates that in a large majority of cases bacteria are the primary cause. In the case reported in this paper, the patient had had a severe attack of mumps a few years previously, and mumps may account for the bacterial origin in a few cases.

A case discussed by C. A. Wheaton, of St. Paul, may give a lead as to the etiology in certain cases. The patient was a middle-aged woman of marked neurotic tendency. Examination showed that abrasion of the occlusal surfaces of the molars and second bicuspids had brought them in contact in such a manner as to favor cheek biting at a point close to the opening of Stenson's duct. The injury to the tissues of the cheek had caused infection, followed by inflammation and occlusion of the duct.

Inasmuch as this paper is mainly a discussion of calculi in Stenson's duct and the parotid gland, a brief résumé of the anatomy of the gland will be given. Stenson's duct passes from the anterior border of the parotid gland transversely across the cheek, on a line passing from the lower border of the concha to a point midway between the free margin of the upper lip and the ala of the nose, about a finger's breadth below the zygoma. Here it lies on the masseter muscle directly beneath the skin, where it can be felt like a whipcord, especially if the masseters are made to contract. It lies between the transverse facial artery above and the buccal branch of the facial nerve below. At the anterior border of the masseter it turns abruptly inward, making almost a right angle. It passes through a mass of fat and the buccinator muscle to the mucous membrane, ending in a papilla opposite the crown of the upper second molar tooth. It is thus divided into a masseteric and a buccal portion, each about 1 inch long. The diameter of the duct is about one-eighth inch; smallest at the papilla.

The symptomatology is varied. The stones are composed principally of phosphates and carbonates of calcium and they vary greatly in size, form, color, and number. The largest number on record occurred in a case reported by Dr. A. H. Noehren, of Buffalo, in which 14 stones were removed from the buccal portion of the duct. Usually they are single and somewhat elongated, especially if situated in the ducts. Those stones situated in the gland are very irregular in outline. They vary in size from tiny grains to stones weighing 20 grams or more. The symptoms are those of foreign body with marked dilatation of the duct, swelling of the cheek and gland, ulceration, suppuration, abscesses, and, at times, salivary fistula. If the obstruction persists, the gland becomes chronically enlarged and its interstitial tissue increased in bulk, while a certain amount of periadenitis results. The history usually shows more or less gradually increasing disturbance, with appearance and disappearance of acute salivary stasis and infection. When swelling becomes marked, pain is at times intense. At times, as in the case of an elderly lady whom I saw as a student, the only symptom may be a chronic discharge of pus from the duct orifice.

If the calculus is situated in the duct, it can usually be felt with the finger or a probe. Usually a fistulous tract is sufficiently clear to be followed into the gland also. When it can not be felt, a radiograph must be relied upon. Ludwig's angina, phlegmonous angina, alveolar periostitis, dento-alveolar abscesses, lymph nodes, inflammatory tumors, tuberculosis, syphilis, and actinomycosis must be ruled out in a differential diagnosis. These may be recognized by their special diagnostic indications and the demonstration of the

salivary stone by probe or by the Röntgen rays completes the diagnosis.

Whenever possible salivary stones should be removed through the mouth. When they are situated deep within the duct, or in the gland, or when there is an external fistula in direct communication with its surrounding abscesses, then external removal is indicated. The after treatment is immobilization of the jaw, liquid diet, and antiseptic mouth washes. Timely interference is sometimes necessary to prevent occlusion of the duct and the formation of fistula.

In removing calculi from the parotid gland the skin is incised parallel with the course of the facial nerve, the incision being placed over the known or supposed position of the stone. The tissues are carefully dissected down to the gland, avoiding the important structures. The facial or lingual nerves are liable to be injured in working out of sight in the parotid gland. When a single stone has been removed it must not be supposed that no other is present until examination reasonably convinces one that this is the case. Wounds are usually sutured at once if there is no infection in connection with the calculi, otherwise they may be temporarily drained. W. H. Irvine reports a case where 12 stones were removed by this method—the patient was in bed but five days and no fistula developed.

In removal of calculi from the masseteric portion of the duct, which extends from the anterior aspect of the gland to the anterior border of the masseter, the procedure is as follows:

Incision is made in the skin in the middle third of a line drawn from the lower part of the external auditory meatus to the middle of the upper lip. Incision is carried through the skin and then the fascia, care being taken to avoid branches of the facial. The duct is located and incised. After removing the stone, the duct should be probed both in its proximal and distal portions. If the duct is found narrowed in any portion it should be dilated by passing probes of increasing size. The margins of the duct should then be sutured together with fine catgut, dead spaces eliminated, and skin closed. The jaw should be immobilized and the diet liquid, as before. If primary union does not take place fistulæ are liable to follow.

In operating on the buccal portion of the duct, which extends from the anterior portion of the masseter to the mucous membrane, the approach is through the buccal mucous membrane over the course of the duct, guided by counterpressure on the cheek from without. The stone is located and removed as in other methods. Usually, no attempt is made to suture the wound, as fistula in the mouth is not of any importance. Surgically, however, it is more satisfactory to suture the part which extends in the direction of the parotid gland. All the above operations are usually performed under novocain and adrenalin analgesia, although general anesthesia may be employed.

Case Report

S. R., Ch. M. M., U. S. N., age 36, entered the Chelsea Naval Hospital March 8, 1926, complaining of swelling of the left side of the face, with intense pain.

Present illness.—Trouble started eight years ago with a similar swelling of the left side of the face with pain. He went to the Norfolk Naval Hospital, where a stone was removed from the parotid duct. Following the operation the pain disappeared, but the swelling of the left cheek persisted. No discharge was noticed in the mouth and he has had no dental trouble. Within the last year the pain has returned and is, at times, intense, being confined wholly to the left side of the face, with ringing and diminished hearing in the left ear. The swelling has increased considerably during the past year. Eating sour food, such as pickles, increases the pain, which is relieved for a short while by heat applied locally. No sinus tracts noticed at any time. Trouble is getting worse. He thinks that since his present trouble began the vision in the left eye is not so good as it was.

Past history.—The patient had a severe attack of mumps in 1908, with testicular involvement; measles and whooping cough as a child; double pneumonia in 1918; appendectomy in 1923; stone removed from left Stenson's duct in 1918; gonorrhea infection in 1907.

Physical examination.—The patient is an adult male, of the gouty diathesis, ambulatory, well developed and nourished. Height, 70 inches; age, 36; weight, 210 pounds, which is about his usual weight during last year.

Hair and scalp negative. No sinus or mastoid tenderness. Tenderness over diffuse swelling involving the entire left cheek, which is red, rather firm, and tender. On palpation, a tumescence about the size of a horse chestnut, somewhat firmer than surrounding cheek and in the location of the parotid gland, can be felt. No sinus formation. Teeth show six crowns. Dental hygiene is good. The tonsils and tongue are negative. The orifice of left Stenson's duct is enlarged and reddened, but there is no discharge.

Otherwise, physical examination is negative.

X-ray report.—There are four shadows of increased density in the region of the superior maxillary bone which have the characteristics of stones in the parotid duct and gland.

March 11, 1926.—Operation performed this date under novocain-adrenalin analgesia. Duct opened through buccal mucous membrane. Two stones removed. One stone not removed, as it could not be removed through this approach.

March 15, 1926.—The swelling of the cheek has persisted, although the pain has abated considerably. The remaining stone, which is probably in the parotid gland, will have to be removed at a later date by the external route. This patient is of the constitution often found in those suffering from gallstones. Whether or not this is also a predisposing factor in salivary calculi is not certain. The severe attack of parotitis in 1908, and the numerous gold crowns, indicating dental trouble in the past, may also be determining factors in this particular case.

BIBLIOGRAPHY

1. Rose and Carliss: Manual of Surgery, 10th ed., pp. 952–953.
2. Bickham: Operative Surgery, vol. 3, pp. 520–528.
3. Noehren, A. H.: Multiple calculi in Stenson's duct, J. A. M. A., 80: p. 25.
4. Canadian M. A. J., June, 1923 (abs.), p. 138.
5. Hays, S. C.: Jour. So. Car. Med. Assoc., 19: pp. 519–520.
6. Brown: Oral Diseases and Malformations, 3d ed., pp. 411–413.

SPONTANEOUS PNEUMOTHORAX [1]

WITH REPORT OF CASE

By B. S. PUPEK, Lieutenant (Junior Grade), Medical Corps, United States Navy

Pneumothorax signifies the presence of gas in the pleural cavity. The gas may be *hydrogen*, a product of the action of certain of the gas bacilli, in rare cases where the pleura is attacked by these organisms; *nitrogen*, the substance frequently used to produce artificial pneumothorax; or, most commonly, *air*, which enters the pleural cavity when it is opened and exposed to the atmosphere. The term "spontaneous" is descriptive of that class of pneumothorax which occurs without any appreciable provocative cause in an apparently normal individual. Of course this excludes those types which are due to artificial means, trauma, manifest lung pathology, ulcerative communication between the alimentary tract and the pleural space, empyema, and other similar causes.

In a study of spontaneous pneumothorax, pulmonary tuberculosis is at once brought to our attention. It is almost universally agreed among authorities on this subject that 90 per cent of all pneumothorax has its origin in a tuberculous focus in the lung. Some even venture to state that all cases of the spontaneous variety are due to tuberculosis. Others concede that the great majority are caused by this one factor, but that in a definite small percentage no evidence of a tuberculous process can be demonstrated either clinically or pathologically, even after the most minute search. Here it is speculated that the etiological factor is the bursting through the pleura of an emphysematous bleb, which in turn had been formed by the gradual but continual undermining of the pleura by air escaping from a ruptured air vesicle. This bleb, by causing pressure on a localized spot in the pleura, interferes with the blood supply of that part and thus weakens it. The actual rupture of the air vesicle may have occurred months or even years previously, due to some incident where the intrapulmonic pressure was suddenly and greatly increased. That normal lung tissue is susceptible to rupture when put under great strain is evidenced by the report of rare instances of pneumothorax in parturition or during a violent paroxysm of whooping cough.

Referring again to tuberculosis, it is estimated that pneumothorax occurs in 1 to 2 per cent of all tuberculous patients, and Pottenger quotes 10 per cent as being the incidence in advanced sanitarium cases. It is most common in the rapidly advancing active forms. Pneumothorax due to tuberculosis may be the result of the rupture of an old cavity or the perforation of the pleura by an acute focus

[1] From U. S. Naval Hospital, New York.

subjacent to the pleura. In either case the pneumothorax soon becomes a hydropneumothorax or a pyopneumothorax, due to contamination of the surface of the pleura with septic material. Uncomplicated cases are comparatively rare, these occurring in the so-called true nontuberculous pneumothorax.

The pathological physiology is interesting in that the clinical picture is made clearer. Normally, the intrapleural pressure is less than the intrapulmonic pressure, and the former is constantly changing, increasing on expiration and decreasing on inspiration. If these two conditions do not obtain, respiration is not possible. When the intrapulmonic pressure does not exceed the intrapleural pressure by an amount greater than the force exerted by the intrinsic elasticity of the lung tissue, the lung collapses completely, unless held to the parietal pleura by adhesions.

There are three types of pneumothorax, (1) closed, (2) open, and (3) valvular. The valvular type is practically always the one present in the spontaneous form, because here the pulmonic pleura is perforated, the lung collapses, and the tissues in the vicinity of the tear act as a flap or valve. Air thus enters the pleural space easily, but is hindered in its attempt to return to the bronchial system. Air will pass through the valvular flap into the pleural cavity so long as the intrapleural pressure at the height of inspiration is less than that of the intrabronchial at the same time. In this way, the intrapleural pressure during inspiration is atmospheric pressure. As the bony thoracic cage collapses during expiration, the intrapleural pressure on the affected side exceeds the atmospheric or intrapulmonic pressure. Thus, in inspiration, the mediastinum retracts slightly toward the affected side and the diaphragm on the affected side ascends. Upon expiration the mediastinum bulges toward the sound side and the diaphragm on the affected side is depressed. The action of the diaphragm noted here is paradoxical. The movement of the mediastinum increases the efficiency of respiration on the unaffected side. In valvular pneumothorax, the possibility of grave respiratory upset is remote if the unaffected lung, prior to the accident, was approximately functionally normal. This is in view of the fact that, experimentally, an animal at rest can breathe with but one-tenth of the lung surface functioning without being dyspneic. The degree of dyspnea resulting is thus, for the greater part, dependent upon the functional capacity of the unaffected lung before the pneumothorax occurred. Dyspnea, if present, is also to a lesser extent increased by the displacement of the heart and great vessels. The pain which, in the great majority of cases, signals the occurrence of spontaneous pneumothorax is due to the laceration of the pleura, which is almost everywhere sensitive to pain. The cough, common in all

kinds of pleural irritation, is practically always present, and is of the dry, unproductive variety. If the pneumothorax becomes complicated by the presence of effusion or exudate, the picture becomes like that of hydrothorax or empyema.

The physical findings in pneumothorax are somewhat varied. Upon observation, the patient may not show any signs of discomfort. The side of the chest affected may appear somewhat larger and usually shows a definitely diminished respiratory movement. The apex beat of the heart may be dislocated to the left or right, depending upon the side affected. The liver may be displaced somewhat downward. The vocal fremitus in most instances is decreased or even absent on the side of the collapsed lung. Upon percussion the most usual sign is hyperresonance or actual tympany. Slight dullness may be present if there is a marked positive pressure in the pleural space. Diminished breath and voice sounds, distant bronchial breathing, or even absence of breath sounds may be found upon auscultation. The coin test is very valuable if present, but this may also be elicited over large cavities. The succussion splash is, of course, another characteristic sign. Metallic tinkling is more common in those cases where liquid and air exist together, but may also be present in the absence of any liquid. There is ordinarily increased volume to the breath and voice sounds on the unaffected side. With this array of clinical symptoms and physical findings, a diagnosis may be made in the majority of cases, especially if this condition is kept in mind. The means of diagnosis "par excellence" is the X ray. Here a characteristic picture is given. If there are no adhesions, the lung is shown to be completely collapsed against the mediastinum, and there is a definite demarcation between the shadow cast by the dense lung tissue and the clearness of the air-containing cavity. There may be displacement of the heart and depression of the diaphragm. If liquid is also present, there is usually a straight fluid line sharply marking off the air above. This picture is very rarely given in any other conditions. If the collapse of the lung is only partial, due to adhesions, the diagnosis is made very much more difficult, both as regards physical findings and X-ray examination.

The prognosis is best in those cases that are not complicated by infection of the pleura by the extruded septic material. It even happens in some cases where there is a unilateral lesion of tuberculosis, that the occurrence of pneumothorax may actually help to heal the lesion by the temporary splitting, on the basis that fibrosis occurs more rapidly in a lung that is put at rest.

There is no specific treatment for this condition, except to carry out the wise guidance of diet, hygiene, and taking care of symptoms

as they arise. If the cough is troublesome, codeine may be given as a sedative. Rest should be enforced at the beginning so as not to put too much of a burden on the sound lung, and also to keep the affected lung at rest until the tear has been healed. Physical findings and X-ray pictures, taken at frequent intervals, will show the progress of reexpansion. Heroic measures to relieve embarrassment of respiration and displacement of vital viscera are never needed as in some cases of surgical pneumothorax.

Case Report

D. L., a veteran, aged 34 years; occupation, garment cutter; nationality, Hebrew.

Family history.—Negative. No history of tuberculosis in near or distant relatives.

Previous history.—Measles during childhood; gonorrhea in 1916; shrapnel wound of thigh in 1918; influenza for two weeks in 1918. For the past six years patient says he has had a slight nonproductive cough, which has persisted, but otherwise has been of no consequence. He has enjoyed normal health for many years. Gives no history of loss of weight, weakness, night-sweats, hemoptysis, or other manifestations of tuberculosis.

The essential physical findings upon admission, September 23, 1925, were as follows: Patient is ambulatory and does not appear ill in any respect. His weight is 148 pounds and height 5 feet 9 inches. Chest is well developed, as is the rest of the body. General respiratory excursion seems to be normal and equal on both sides. Tactile fremitus somewhat less on right side than on left. Percussion on left side normal. There is, however, on the right side, especially noted over the lower two-thirds of the chest, a note which ranges from hyperresonance to tympany. Left chest is normal to auscultation. Over the right chest, particularly the middle and lower lobes posteriorly, there may be heard distant bronchial breathing. Over this same region spoken voice is also distant but of a higher pitch than on the left side. No definite râles heard, but over right chest posteriorly, during inspiration and expiration, there is heard a series of extraneous squeaky sounds not unlike the crinkling of dry leather.

Patient relates that on or about September 1 (three weeks previously), while seated at his work, he suddenly noted a sharp, sticking pain in the right chest in front. This was immediately followed by a troublesome, unproductive cough. The pain soon became less severe but persisted for the next two weeks, during which time the patient continued with his work and usual activities. Because the pain and cough did not entirely disappear patient consulted a physician. After examination patient was told he had probably ruptured his lung and was advised to go to a hospital and have an X-ray examination. Upon entering this hospital the pain and cough were of only slight annoyance to patient.

Wassermann test, urine examinations, and blood count revealed nothing abnormal. What few specimens of sputum were obtained were negative for the tubercle bacillus. Report of the X-ray examination on the day of admission was as follows: "Complete pneumothorax of right side."

The patient was put at rest for a week to ten days. In this time the pain and cough had disappeared.

The progress of the case is best told by the X-ray reports. One report, two weeks after the first, reads: "Increased expansion noted at the base." One week later the report was: "Continued expansion at base." On October 19, or four weeks following admission, the report read: "Considerable increase in the expansion of the right lung noted; superior margin of lung just below inferior border of the clavicle in nipple line." Two weeks following this there was complete expansion of right lung, except at the extreme apex. On November 7, or a little over six weeks following entrance to hospital, about nine weeks after first symptoms appeared, the X-ray specialist reported: "Complete expansion of right lung; it is believed that no chronic disease of the respiratory tract, as evidenced by X ray, now exists." The recovery was uneventful and was complete in six weeks. During entire stay in hospital there was no evidences of active tuberculosis of the lung. The temperature was at no time above 99° F. and the pulse and respiration were always normal.

The most important issue in this case is whether or not there was a tuberculous basis present. Although this can not be entirely ruled out, the evidence in favor of it is insignificant as compared to that against it. The patient was well nourished, and except for a rather persistent cough for several years he complained of no symptoms. There is a faint possibility, of course, that this cough was due to tuberculosis. Of equal possibility it may have been caused by pleural irritation of an emphysematous bleb, as mentioned previously. The normal physical findings after reexpansion of the lung, the uneventful recovery, the absence of fluid complications, the failure of the X ray to reveal any lung pathology—all of these speak against tuberculosis. The only suspicious factor, possibly, in the previous history was the occurrence of influenza eight years ago. This element is of obscure value in the light of our present knowledge.

If this were a case due to tuberculosis, the process certainly must have been a mild and small one, indeed, to have kept itself concealed so successfully, both as to symptoms and X-ray findings. The difficulty in ascertaining the true etiology in this particular condition exists because of the paucity of post-mortem investigation, as most cases recover.

REFERENCES

Hewlett: Functional Pathology, Monographic Medicine.
Pottenger: Clinical Tuberculosis.
Rost: Pathological Physiology.
Osler: Principles and Practice of Medicine.
Da Costa: Modern Surgery.
Bickham: Operative Surgery.
Nelson: System of Medicine.
Tice: System of Medicine.

CUTANEOUS MELANOSARCOMATA WITH LYMPHATIC INVOLVEMENT[1]

With Report of Case

By G. Jelstrup, Lieutenant (Junior Grade), Medical Corps, United States Navy

A cutaneous melanoma is a pigmentiferous tumor caused, usually, by irritation of a mole or nevus found anywhere on the body. Pathologically, melanomata correspond to sarcomata in other structures. Clinically, they are characterized by their rapid growth and malignancy.

Authorities disagree as to their origin, some being of the opinion that they arise from the epidermis, others that they are of mesodermal origin, and a third group believes they are specially characterized cells of mesodermal origin. They usually arise in the skin, choroid coat of the eye, meninges, or rectum; less frequently in other organs.

The cutaneous melanoma usually arises from a pigmented mole or nevus found chiefly on the face, back, and neck; but they may appear anywhere on the body. Its symmetrical and unilateral distribution and its relation to nerve trunks have been noted. Some suggest implication of hair follicles by the growth of soft or coarse hair in the pigmented mole; others suggest complex dermal structures in the larger tumors by the presence of connective tissue and fat. Pigmented moles are sometimes suspected of having some relation to vascular nevi and the molluscum fibrosum. Bayet suggested that the melanotic whitlow described by Hutchinson arose from the flat pigmented lesions called lentigo. In other cases no local point of origin of the disease can be demonstrated clinically or by autopsy.

A congenital disturbance of the structure of the derma must be assumed for all cases.

Some moles are visible at birth; they show slow, progressive growth to a point where they have apparently reached a limit. Then these growths show fibromatous or mulloscoid degeneration. A very small percentage of these cases become malignant, forming what are called either the melanosarcomata or melanocarcinomata. The causative factor in most cases is obscure. Local irritation, gross trauma, or meddlesome treatment and incomplete extirpation have been ascribed as etiological factors. Metastasis may be either through the blood or lymph stream, and may appear early or may be latent, following an incomplete extirpation. Local recurrences as late as 24 years have been reported.

Aside from painless, firm nodules, which may be superficial, small and numerous, there may be large hemorrhagic masses. Associated with these, melanemia, melanuria, and cachexia develop and are usually found in older cases.

[1] From U. S. Naval Hospital, New York, N. Y.

The differential diagnosis between carcinoma and sarcoma can only be made by microscopical examination. An important point is the recognition of the first evidences of beginning growth in a mole, for metastatic growths may develop from such tumors before any marked change in the primary lesion takes place.

Treatment is unsatisfactory and may be divided into two stages.

First: Prophylaxis; avoiding meddlesome interference of the innocent appearing mole by patient, practitioner, or specialist.

Second: Complete extirpation of the circumscribed tumor. The excision should be made as wide as possible to include the limits of its growth, with care to avoid transplantation of any particles.

This should be followed by deep X-ray therapy to the point of an acute reaction; followed by subsequent treatments of slightly less intensity at intervals of a few months. Combined with this treatment, hypodermic injections of arsenic have been used. As a last resource, injections of erysipelas and prodigiosus toxins have been tried.

The prognosis in all cases where signs of malignancy are present is grave.

Report of Case

J. E. H., veteran, was admitted to the United States Naval Hospital, Brooklyn, N. Y., December 15, 1925, with "Diagnosis undetermined (sarcoma), left foot."

Occupation, till admission to hospital and since discharge from Army, merchant.

Past history.—He recalls only having had rheumatism a few years ago and an appendectomy in 1914. His habits have been temperate; uses alcoholic beverages rarely, coffee moderately; abstains totally from the use of drugs and tobacco.

Family history.—Negative.

Immediate complaint.—On admission he complained as follows: (1) A small painful growth on medial surface of left foot; (2) swelling in left groin.

Patient's story dates back to 1918, at which time he received a simple fracture of the first metatarsal bone of his left foot, for which a cast was applied. This cast, he states, was very painful and fitted the foot very firmly. Following the removal of the cast he received bakes locally to the left foot. At this time a small reddish spot was noticed on the skin at a pressure point of the cast, over the region of the fracture. Little attention was given to the area and he was discharged from the Army in August, 1918, seven months after his fracture. Last July, seven years later, the persistent, little, reddish area became active. It enlarged, became moist and painful. A month later the patient's left groin became swollen, indurated, and reddened, and red streaks extended from his foot to his groin, on the left side. A local physician was called who treated the involved areas with ointments and iodine until December, 1925, at which time he was sent to this hospital.

Physical examination.—Well-nourished white male. Actual age, 34; apparent age, same. Weight, 180 pounds, 20 pounds in excess for his height, build, and age. His strength was good. He was fair complexioned and his face ruddy. He walked with a limp, favoring his left foot.

The nasal septum was deviated to the left. Both tonsils were enlarged, cryptic, and chronically diseased. Several carious teeth were present. There were two small pigmented nevi on the back of his neck and two at the lower costal border on the left side anteriorly.

On the medial surface of the left foot, in the region of the distal third of the first metatarsal, there was a growth the size of a quarter, which was red, vascular, moist, tender to pressure, and cauliflower in appearance. The femoral lymph nodes in the left groin were large and indurated so that their entire area was markedly swollen, hyperemic, and slightly painful on palpation. Elsewhere the lymph nodes were not palpable. Rectal examination was negative. Abdominal examination was negative. The chest revealed only a few harsh breath sounds over both lung areas. The temperature, pulse, and respiration were all within normal l mits. Hgb., 82 per cent. WBC., 8,552. Polys., 60 per cent. Lymph., 38 per cent. Mono., 2 per cent. Eosin., 1 per cent. Basophiles, 2 per cent. Routine and microscopical examination of urine, negative. Wassermann test, negative.

X-ray examination showed a bony roughening of the first metatarsal bone of the left foot with a moderate amount of loss of density of the adjacent bones. From a radiographic examination it was extremely doubtful that the lesion was a sarcoma of the bone.

His appetite was good, his bowels were regular, and he slept well. The patient's mental attitude was attentive, intelligent, cheerful, and cooperative.

His diagnosis was changed to melanosarcoma and he was sent to Memorial Hospital for deep radiations of his left groin and removal of the primary growth on his left foot.

CONCLUSIONS

This case is of peculiar interest because of—

1. Its relatively obscure origin. Was it produced by local trauma to a previously normal structure, or was there at that site a mole?.
2. The period of seven and one-half years quiescence.
3. Its rapid growth and malignancy.
4. The regional metastasis with involvement of the adjacent lymph glands, which is rarely found in sarcomata.

CEREBROSPINAL FEVER

REPORT OF CASE

By R. L. NATTKEMPER, Lieutenant Commander, Medical Corps, United States Navy

The patient covered by this report was a hospital corpsman, 20 years of age, who had been in the service two years.

He was in attendance upon a fatal case of virulent cerebrospinal fever, and five days later noted a soreness of the throat, general malaise, and nausea. A spinal puncture was done in the evening of the day of his first symptoms, and a clear fluid was obtained, not under pressure.

The following morning his temperature was 102°, pulse 110. There was severe continuous headache, vomiting, rigid neck and spine, positive Kernig sign, and a few petechial spots over the trunk and

flexor surfaces of the forearm. Marked drowsiness was present and patient appeared seriously ill. Spinal puncture gave a very slightly turbid fluid, and there was no marked increase of pressure. Cell count, 640. Globulin positive. Smear and culture of fluid positive for meningococci. The white blood count was 13,850, with 79 per cent polynuclears. Antimeningococcic serum, 30 c. c., was given intraspinally. At this time there was a poor color and a pulse of poor tone. The stupor gradually deepened during the day. Cyanosis became marked and the skin cold and clammy. Temperature was subnormal, and by 4 o'clock in the afternoon patient was in profound collapse, with shallow, rapid respirations, and pulse imperceptible at wrist. At this time large irregular ecchymotic blotches were present over trunk and limbs.

Maximum cardiac stimulation was immediately given and continued over a period of 12 hours. One hundred and five cubic centimeters of undiluted serum were given intravenously and 30 c. c. more given intraspinally. The following morning patient was conscious and generally much improved. There were then given, at 24-hour intervals, six more intraspinal injections of antimenigococcic serum of 30 c. c. each. No reactions to the resum occurred, except that following the fifth intraspinal injection the pulse became very rapid and iregular, associated with rapid, shallow breathing and marked cyanosis. This condition developed in a few moments after the serum was given. Atropine and adrenaline were given, and symptoms rapidly subsided.

In the following few days the meningeal symptoms rapidly subsided, but at this time there appeared to be serious myocardial involvement. A slight degree of cyanosis persisted, with rapid, irregular pulse, very faint sounds, but no murmurs or friction sounds, and only slight left lateral enlargement to percussion noted. A marked productive cough developed, with blood-streaked sputum. On the thirteenth day of illness, after temperature had been normal for six days, a sharp rise of temperature to 102° occurred, associated with an exaggeration of pulmonary symptoms. A broncho-pneumonia developed, which ran a rather subacute course, and from which, clinically, the patient was satisfactorily convalescing when gradually progressive signs of lack of cardiac compensation occurred. Patient was digitalized with no apparent benefit, and death occurred on the forty-second day of the disease from gradual heart failure.

Electrocardiogram.—Inverted ventricular muscle waves in second lead. Diphasic auricular wave in Lead I. Low amplitude of muscle waves throughout and variations in amplitude of R and S waves.

Interpretation was indicative of serious myocardial change. Left lateral, supine, and right lateral positions indicated fair degree of mobility of heart.

Röntgenogram of heart, one meter distant.—Restriction of the left lung along the axillary border. The left diaphragm is highly arched. Both lung fields are hazy. Heart shows diffuse enlargement suggestive of a dilatation with myocarditis. Blood cultures taken on twenty-third and thirtieth days of disease were negative.

Autopsy report.—Well-developed young man with no gross abnormalities apparent. There were a few small adhesions in upper right chest. There was broncho-pneumonia in whole lower right lobe with one small patch in the lower part of the middle lobe of the lung. There were no adhesions of the left pleura but the whole lower and part of the upper lobes of the left lung were involved in the broncho-pneumonia. The pericardium was markedly thickened and firmly adherent to the myocardium by thick, short adhesions that snapped loose under pressure. The sac contained some 5 c. c. bloody fluid. These adhesions entirely surrounded the heart and seemed to penetrate into the heart muscle. The heart muscle was not definitely hypertrophied. The right auricle was enlarged, the right auriculoventricular valve was sclerosed, and the ring showed a relative insufficiency. There were no growths or vegetations on any of the valves.

Liver and kidneys and spleen congested but no gross abnormality presented itself. The gut and bowel appeared normal.

Autopsy diagnosis.—Pericarditis and broncho-pneumonia.

It would seem that there is considerable difference of opinion as to the advisability of combining the intravenous administration of serum with the intraspinal and also the frequency and amount to be given.

The organism causing cerebrospinal fever has an affinity for the meninges and does not apparently cause serious trouble elsewhere except in isolated cases. It may be in the blood stream, but only in the very earliest stages before it is possible to make a diagnosis. Since it is practicable to introduce the serum directly into the spinal canal, and since that is the place where the greatest concentration of serum is desired, there is no indication at any time to give this serum intravenously unless the case is one of a fulminant, septicemic type. There is also a great danger of very serious reactions following the combined administration.

Antimeningococcic serum is primarily bactericidal and it also raises the bactericidal power of the spinal fluid, which reaches its maximum in about 12 hours after the serum has been introduced. For this reason, the introduction of serum intraspinally once every 24 hours, and not oftener, obtains the benefit of the raised opsonic power of spinal fluid, while if punctures are done more often, high bactericidal spinal fluid is withdrawn.

The quantity of serum introduced should always be less than the amount of fluid removed, and only in exceptional cases should 30 c. c. of serum be exceeded.

An average of six injections is sufficient for the usual moderately severe cases.

NOTES AND COMMENTS

THE AMERICAN RED CROSS PEACE PROGRAM

Many think of the American Red Cross as essentially an adjunct of those stirring days of 1917–18, when it symbolized the humanitarian side of the grimmest period of the world's history. They have forgotten that suffering in the world did not cease with war, that lives are needlessly lost, people injured, just as in war.

It is to meet the suffering and injury of sudden disaster of peace and to minister to the needs of many others in need of the sympathetic human touch, as well as to render a growing and practical service of everyday life in many directions, that the American Red Cross shaped the program in effect to-day.

The best way one can further this vital service to his fellow is through membership in the Red Cross. Join during the Roll Call, November 11–25.

THE EYE AND THE INTERNIST

Under this title, Maurice Fremont-Smith, M. D., writes in the Boston Medical and Surgical Journal of May 27, 1926, on the importance of observing the eye of the patient in order to find clues to the correct diagnosis of his condition. He states that "* * * the eye, however, holds within its small compass more possible general diagnostic information than can be obtained from any other one region of the body; and this fact entitles it to a very respectful consideration from the diagnostician."

To illustrate the value of observing the eye in every patient, the author cites several cases from his own experience. One patient, a man with a very large liver, was found to have a glass eye. Questioning disclosed the fact that the eye had been enucleated because of melanosarcoma and the diagnosis of the abdominal condition was at once suggested.

Among the conditions in which the eyes may point the way to diagnosis are mentioned: Diabetic coma, in which unusually soft eye balls occur; myxedema, evidenced by loss of outer third of the eyebrows; leprosy, shown by thickening of the skin and subcutaneous tissue beneath the outer half of the brow; trichiniasis and arsenic

poisoning, by puffiness of the lids; lymphatic leukemia, thrombosis of the cavernous sinus, aneurysm of the ophthalmic artery, tumor or abscess of the orbit, suggested by unilateral exophthalmos; obstruction of the common duct, infection or sclerosis of the liver, are brought to mind by jaundice of the scleræ; petechial subconjunctival hemorrhage may point to subacute bacterial endocarditis in a patient who has been thought to have only rheumatic heart disease; conjunctivitis, iritis, and glaucoma must be differentiated by the appearance of the eye; corneal scars, irregular or unequal pupils, or pupils which react sluggishly are of great diagnostic import; cataract, before the age of 50, is often diabetic in origin; paralysis of the ocular muscles may be due to any one of many causes—if unilateral, a lesion in the nucleus or the peripheral motor nerve, injury, meningitis, sinus disease, or neuritis; diplopia may suggest botulism or encephalitis; cocaine poisoning, dilated pupils; morphine poisoning, pin-point pupils; pituitary tumor is suggested by bitemporal hemianopsia, and lesions of the optic tract posterior to the chiasm, by homonymous hemianopsia; impairment of vision may point to disease of the accessory sinuses, poisoning from tobacco, alcohol, wood alcohol, quinine, chloral, lead, or other industrial poisons: transient unilateral blindness may be the first sign of multiple sclerosis; hemorrhage into the vitreous or obstruction of the central retinal artery or vein may be the cause of sudden unilateral blindness.

The eye signs of syphilis, nephritis, Graves's disease, catarrhal jaundice, gonorrheal ophthalmia, and many other conditions are so familiar to all that it is not necessary to discuss them.

Enough has been said to show the importance of a close study of the external eye by the internist. In addition, he should be able to use the ophthalmoscope and to interpret his findings intelligently. It is not necessary that every internist be a skilled ophthalmologist, but he should be able to recognize the abnormal and know when it is wise to refer his patient to an expert.

In conclusion, Fremont-Smith says:

"The eye thus offers a wealth of diagnostic information. Few eye signs are final; most of them are suggestive, merely, of possibilities; but as clues to be followed up and proven or disproven by further study, they are invaluable aids in diagnosis. The eye deserves from the clinician the most profound respect."

CHRONIC APPENDICITIS

In the minds of many medical men, as well as in the mind of the layman, numerous ills are attributed to chronic disease of the appendix when no other cause can be found. On the other hand, many

physicians and surgeons question the existence of chronic appendicitis when there has been no history of an acute attack.

In Surgery, Gynecology and Obstetrics for May, 1926, there is an editorial by W. J. Mayo dealing with this question. Doctor Mayo, than whom there is no one better qualified to speak, shows that there are two forms of chronic appendicitis that are well defined. He says, "In the first type, the appendix contains fecal concretions, often of considerable size, and sometimes to the touch like a string of beads. Occasionally one sees a case of unexplained hemorrhage from the stomach in which finally an exploratory operation reveals no other cause than such an appendix. Following removal of the appendix the patient has no more hemorrhages, gains greatly in weight, and apparently gets well. One may assume that this recovery is a coincidence, and not a consequence of the appendectomy, but certain careful observers believe that a chronic infection which is carried to the liver from the appendix is responsible for the hemorrhagic erosions of the mucous membrane of the stomach, which are sometimes found in these cases. The French have written interesting contributions on this condition.

"In the second type, one exploring for a perplexing epigastric condition does not find lesions in the upper abdomen, but brings to light a markedly diseased appendix buried in a mat of adhesions, when there has been nothing in the clinical history to indicate that the patient ever had an acute attack of appendicitis. An appendix of this type is often seen in conjunction with cholecystitis without stones. Moynihan suggests that possibly such an appendix may be related, etiologically, to duodenal ulcer. These two varieties of appendicitis, unless there is retention of secretions or local peritonitis, do not give rise to pain in the right iliac fossa, but painful sensations are referred to the epigastric region and are recognized clinically in a considerable group of cases as appendiceal dyspepsia from the associated pyloric spasm."

Appendicitis obliterans, which was formerly recognized as a type of chronic appendicitis, can not rightly be considered such. Mayo shows that the appendix, like the tonsil, contains lymphoid tissue which undergoes trophic changes with age. These changes begin at the tip and extend to the base. When complete they produce the obliterated appendix which can not be considered pathological.

Mayo brings out the fact that in chronic disease states of the appendix there is no pain or tenderness on palpation in the right iliac fossa because there are no direct nerve connections with this region. Instead, distressing sensations are referred to the epigastric region because "the autonomic nervous system of Langley formed by Gaskell's nerves from the anterior horns of the spinal cord to the great

sympathetic ganglia, with the vagus and the pelvic nerve, forms the great thoracic and abdominal nerve plexuses, and gives the appendix its nerve supply. We have learned only recently that these nerve fibers are also nerves of sensation * * *."

In conclusion, Mayo tells us, "Mistakes in diagnosis are made because of overemphasis of the possibility that pressure on a chronically diseased appendix, without localized peritonitis and retained secretions, causes pain at the so-called McBurney's point.

"The neurasthenic patient, whose attention has been focused on the right iliac fossa, a region which has been subjected to repeated, sometimes rather painful, manipulations to elicit tenderness, is operated on for the removal of an appendix undergoing normal involution, and the operation, the failing to give the relief expected by the patient, unless from suggestion, is humiliating and disappointing to the surgeon.

"The misinterpretation of the changes in the appendix as a result of involution which have been miscalled chronic appendicitis has probably led to most of the difficulty in cases of what has flippantly been called 'right-siditis.'"

DIAGNOSTIC FINDINGS IN THE MORE COMMON CLINICAL TYPES OF HEART DISEASE

In the Atlantic Medical Monthly for May, 1926, there appeared an epitome prepared by S. Calvin Smith, M. D., of Philadelphia, of a paper by John D. McLean, M. D., secretary of the Pennsylvania Heart Association, with the title given above. It stated so concisely and so clearly the points that should be in the minds of all who conduct physical examinations that it is quoted in full:

"The term 'organic heart disease' refers to actual pathologic change occurring in the structure of either the valves or the muscle of the heart. While it is inconceivable that one particular type of heart structure can be affected without adjacent structures being involved to some degree, nevertheless a valve lesion may overshadow any coincident muscle involvement. Likewise, muscle involvement may dominate the picture of cardiac pathology.

"Cardiac Aphorisms

"Before enumerating the findings which differentiate the common clinical types of heart disease, a few truths, succinctly expressed, may clarify our studies.

"1. Murmurs are of endocardial significance; arhythmias are of heart-muscle import.

"2. The muscle is of more importance than the murmur; the rhythm is of more importance than the rate.

"3. A murmur may occasionally be due to stretching of a valve ring by an enlarged heart which draws the valve leaflets temporarily apart.

"4. A murmur, to be significant of structural valve disease, must be accompanied by other confirmatory signs.

"5. Actual heart disease is rarely primary. It is usually secondary to infective processes elsewhere in the body.

"FINDINGS IN VALVULAR HEART DISEASE (MITRAL STENOSIS)

"1. Apical presystolic thrill.
"2. Apical presystolic murmur, sharply defined.
"3. Snappy second sound at mitral area.
"4. Heart enlarged to right; also perhaps to left.
"5. Thready, rapid pulse.

FINDINGS IN VALVULAR HEART DISEASE (AORTIC INSUFFICIENCY)

"1. Basal diastolic murmur.
"2. Murmur transmitted over precordium.
"3. Heart enlarged to left (cor bovinum).
"4. Sharp, sustained pulse impact, artery collapsing between beats.
"5. Low diastolic pressure, persisting as indicator drops to zero.
"6. Pistol-shot sound in femoral artery (normally void of sound).
"7. Femoral systolic pressure markedly higher than brachial.

FINDINGS IN HEART-MUSCLE DISEASE

"1. History of acute rheumatic fever, St. Vitus's dance, repeated attacks of tonsillitis, diphtheria, scarlet fever, long-continued low-grade infections.

"2. Symptoms of heart failure ("decompensation"); really, symptoms or signs of impaired function, varying with that particular anatomical system which is deprived by the failing heart of sufficient blood with which to function properly, as the central nervous, respiratory, digestive, muscular, or other systems.

"3. Inability to perform accustomed tasks without marked distress.

"4. The pulse is usually disturbed, but not necessarily so. When pulse abnormalities are present, the more serious types are the totally irregular pulse (auricular fibrillation), or a bradycardia (likely a heart block).

"The best available evidence of actual structural heart-muscle disease is afforded by electrocardiographic studies. When the written record shows that heart's action currents are delayed in their passage through the heart muscle, the evidence of myocarditis is incontrovertible.

"8. Many cases of alleged 'chronic myocarditis' are actually nothing else than heart-muscle inefficiency—*not* heart-muscle inflammation. Such hearts can frequently be made surprisingly efficient by locating and removing focal infections, blood impoverishments, chronic constitutional diseases, etc. Persons who have actual inflammation of heart muscle grow progressively worse; those who have simply exhausted their heart-muscle reserve drag along indefinitely with little change from one month to another in their symptoms, signs, or physical capacity.

"7. Leukocytosis is not so characteristic of heart-muscle inflammation, per se, as it is of the chronic infection to which the heart involvement is so often secondary."

MALARIAL AND TRYPARSAMIDE THERAPY IN PARESIS

So much is being written about the effect of artificial inoculation with the malarial parasite in cases of paresis, that we are in danger of losing sight of the possible value of other therapy in this condition.

A short paper by H. H. Reese, M. D., of the Wisconsin Psychiatric Institute, on "A comparison of malarial and tryparsamide therapy in paresis," which appeared in the Wisconsin Medical Journal for June, 1926, while it deals with only a small number of cases, shows clearly that, in the author's experience, tryparsamide has been effective in a larger number of cases than has malarial therapy.

Since December, 1924, 64 paretics have been treated with malarial inoculation at the Wisconsin Psychiatric Institute.

The technique of the treatment as described by Reese is simple. A period of observation, during which one or more lumbar punctures are done and a careful clinical record of the patient is kept, is followed by an intravenous injection of from 3 to 5 cubic centimeters of blood from a patient with tertian malaria. After from four to eight days the patient begins to have definite attacks of chills and fever.

The strain of parasite used by the author has gone through 64 successive passages from patient to patient without losing its effectiveness or becoming resistant to quinine.

"The total number of chills should be from 8 to 15, according to the constitution of the patient. It is true that the patient becomes very anemic and the associated decreased appetite is followed by a marked loss of weight. These conditions do not affect paretics greatly, as they stand these discomforts with the equanimity typical of paresis. Furthermore, recovery takes place within approximately two weeks after quinine medication."

Seven, or 10.9 per cent of the cases studied, died; none as the result of the inoculation.

In the treatment of the malaria, quinine sulphate, grs. 6, is given twice daily for 12 days. A three days' rest follows, after which three days of treatment alternate with three days of rest, until 250 grains have been administered.

A true clinical arrest of the paresis is understood to mean "good health, good behavior and conduct, absence of psychotic symptoms, possession of insight, possibility of being able to earn a livelihood, although stationary neurological symptoms may be present and serology may remain positive."

Of the 64 cases studied, 10 per cent were markedly improved and have been discharged, 25 per cent are working at the institute's farm, and the rest are easier to handle than they were before treatment.

According to Reese, it can not be foretold "how soon the arrest will follow the above therapy; it may occur soon after the cure of the malarial infection or not until several months later."

The author states frankly that "the efficiency of this treatment is based on no known principles."

In the discussion of this paper, Dr. A. S. Loevenhart stated that both malaria and tryparsamide alter the tissue response to the spirochetal irritation, and that probably tryparsamide exerted a greater effect in paresis because it alters more strongly the Wassermann reaction. He also called attention to the fact that in certain paretics neither form of treatment is of benefit, and offered, as a possible explanation of this, the destruction of brain tissue.

Reports on the use of tryparsamide in paresis are encouraging. This drug is the sodium salt of N-Phenyl-glycineamid-p-arsonic acid. It has a feeble spirocheticidal action. In the treatment of paretics it is given intravenously in 3-gram doses, the drug being dissolved in 10 c. c. of freshly distilled water, once a week for eight weeks. Salicylate of mercury injections are also given weekly. A rest period of from five to eight weeks is followed by a similar course. Treatment is continued until the disease is arrested clinically and serologically.

According to Reese, the percentages of clinical arrests in paresis, as stated by various observers, differs according to the type of the disease. He believes, however, that clinical arrest can be brought about in more than 30 per cent and that decided improvement can be secured in 66 per cent. In his cases, besides the clinical evidence of improvement, serological changes have occurred. In 73 per cent the blood Wassermann reaction has become negative, and in 47 per cent the spinal fluid has also become negative after from 16 to 48 injections.

The writer does not consider the danger of producing optic nerve changes with tryparsamide very great, if a thorough eye examination has been made, nor does he consider pathological changes in the fundi a contraindication to its use.

In contradistinction to the effect of malarial therapy, treatment with tryparsamide results in a building up of the patient. While it takes longer to bring about results, it is effective in a much larger percentage of cases, and also results in serological changes which are lacking with the malarial therapy.

While no therapy for paresis which is effective in all cases has been found, much progress has been made in the treatment of this hitherto hopeless disease.

The aim for which workers in this field are striving is expressed by Reese as follows:

"* * * The ultimate goal to be reached in developing antiparetic therapy must be to find a combination of methods of treatment which will render all patients permanently free from progressive neurological symptoms and produce a state of complete serological negativity."

SODIUM TETRAIODOPHENOLPHTHALEIN IN BILIARY OBSTRUCTION

The use of sodium tetraiodophenolphthalein in cholescystography is increasing at a rapid rate and much is known concerning its correct dosage, its advantages, and its contraindications.

Since sodium tetrabromphenolphthalein has been found by some observers to be contraindicated in complete or partial obstruction of the bile duct, it was rather to be expected that the same would be true of the iodine salt.

To verify or disprove this, Stephen J. Maddock, M. D., and Lester R. Whitaker, M. D., of the Laboratory for Surgical Research of Harvard Medical School, conducted experiments with dogs and cats. In all cases the common bile duct was ligated and in some cases severed, so that complete obstruction occurred. Their findings are reported in the Boston Medical and Surgical Journal of May 27, 1926.

The conclusions reached by Maddock and Whitaker, as a result of their experiments, were:

"1. In complete obstruction of the common bile duct no shadow of the gall bladder is obtainable with sodium tetraiodophenolphthalein.

"2. Normal animals after intravenous injection of sodium tetraiodophenolphthalein excrete small amounts in the urine and large amounts in the feces. Animals with complete biliary obstruction, on the other hand, excrete considerable amounts in the urine and also large amounts in the feces. Probably on account of this vica-

rious elimination, the lethal dose of the drug in animals with complete biliary obstruction proves to be only 20 to 30 per cent below that for normal animals. This dose is relatively per kilo 4 to 5 times that necessary to produce a shadow of the gall bladder in man. Furthermore, the damage to the liver produced by sublethal doses, though somewhat more severe in obstructed than in normal animals, is readily repaired.

"In all probability, then, there need be no fear of a fatal outcome from the intravenous use of sodium tetraiodophenolphthalein for cholecystography in a patient who might happen to have a complete biliary obstruction."

BULLETIN OF HYGIENE

In January, 1926, the Sanitation Supplements, which had formed a valuable part of Tropical Diseases Bulletin published by the Bureau of Hygiene and Tropical Diseases, London, were discontinued. In their place there has since been issued the Bulletin of Hygiene, which more than compensates for the discontinuation of the Supplements.

The Bulletin of Hygiene contains information of great value, gathered from all parts of the world by British leaders in all branches of hygiene and sanitation. While this information is intended primarily for the use of British medical officers in the Empire's overseas possessions, it will be of almost equal value to our own medical officers. This is particularly true of the information contained in the sections devoted to ship's hygiene and to hygiene in the tropics.

The Bureau of Hygiene and Tropical Diseases is to be congratulated upon the appearance of this valuable publication in the field of hygiene.

POSTGRADUATE MEDICAL WORK IN LONDON

The Fellowship of Medicine and Post-Graduate Medical Association has affiliated with it some 50 hospitals in London containing 6.000 beds and with large outpatient departments. Many of these hospitals give general and special courses for which the fees are very moderate.

Medical officers visiting London who wish to avail themselves of the services of the association, of which Sir W. Arbuthnot Lane is president, will find the office at 1, Wimpole Street, London, W. 1., where, we are assured, every effort will be made to assist them in arranging for courses in any medical subject in which they may

be especially interested. Other service, such as assistance in finding living places, or advice as to reaching various points in London, will be rendered if desired.

LIBRARY OF THE MEDICAL SOCIETY OF THE COUNTY OF KINGS

The library of the Medical Society of the County of Kings, Brooklyn, N. Y., established in 1844, is now the fourth largest privately owned medical library in the United States. Situated in Brooklyn, it is within easy reach of many naval medical officers on duty in that vicinity or attached to ships undergoing overhaul at the Brooklyn Navy Yard. For this reason, a paper by Charles Frankenberger, librarian, entitled "How to consult the medical library and medical literature," and published in the Long Island Medical Journal of February, 1926, is of particular interest.

Mr. Frankenberger gives an interesting account of the beginnings and growth of the library and of the way in which it performs its functions as well as much good and practical advice as to how medical literature may best be consulted. He states that many physicians hesitate to write for publication because they are "* * * unacquainted with the proper and orderly manner of preparation and arrangement of the matter which they wish to present and somewhat hesitant about the form of expression to be employed."

We feel sure that this must be true of many of our naval medical officers; otherwise, with the wealth of material available, about which they might write, the number of papers received by the BULLETIN would not be so disappointingly small. We hope that many of them will profit by the advice given in Frankenberger's paper and thereby gain that assurance which will enable them to "rush into print" without fear.

Among the helps for writers of medical papers recommended for use by the author are Sir T. Clifford Allbutt's well-known book, "Notes on the Composition of Scientific Papers;" "The Writing of Medical Papers," by Maud H. Mellish; the American Medical Association's "Suggestions to Medical Authors and A. M. A. Style Book, with a Guide to Abbreviations of Bibliographic References;" and "The Art and Practice of Medical Writing," by Simmons and Fishbein of the Journal of the A. M. A.

Study of all of these will be of value to the inexperienced writer and the carrying out of the principles given in them will make good papers better.

Unfamiliarity with indexes to medical literature is given as another reason why most physicians do not know how to consult the

literature. As Mr. Frankenberger says, the staff can not undertake to do the actual work of finding references for all who consult the library, but they will gladly assist by showing the consultant how to use the various indexes. A few quotations from his article will throw much light upon this subject.

"It depends upon what the investigator has in mind as to what sources he shall consult to obtain the literature desired. If he wishes only to read some of the latest articles upon a special subject his quickest method would be to use the Quarterly Cumulative Index to Current Medical Literature, a special publication issued by the American Medical Association. This index is published four times a year. Being cumulative, each issue includes all references in earlier numbers of the current year. The fourth or last number includes the references for the entire year. It does not pretend to cover the entire field of medical literature, but gives references to the articles contained in a selection of about 275 of the more important American and foreign medical periodicals. * * * Authors and subjects are arranged in one alphabet. At no time in the year is it necessary to consult more than one alphabet to learn what articles have been written by a certain author or what articles have been written on a given subject during the year. It is also useful in expeditiously finding the reference where one remembers only the author's name and about the time of the year the article was published.

"If, however, the investigator wishes to make a thorough search of the entire field of medical literature to obtain the references to all the cases reported upon a particular subject, his most expeditious and systematic method would be to consult the Index Catalogue of the library of the Surgeon General's Office. This publication is a combined index of authors and subjects, arranged in dictionary order in a single alphabet, of the literature contained in the library of the Surgeon General's Office at Washington. This library, of over 350,000 volumes and 460,000 pamphlets, maintained by our Government, is the largest medical library in this country and the second largest in the world, surpassed only by the library of the Paris Medical Faculty. Its collection of periodicals is the largest and most useful in existence. It subscribes for or receives regularly practically every medical periodical published, numbering nearly 2,000. These, together with the books, pamphlets, dissertations, and theses received, are all indexed under authors and subjects in the Index Catalogue. A volume has been published annually beginning with 1880 until the entire alphabet was completed, followed by a second series beginning the alphabet over again and containing the additions since the publication of the first series. A third series is in course of publication.

"Let us assume that our investigator wishes to look up the literature on 'Enlargement of the thymus gland.' In volume 14 of the first series of the Index Catalogue under the heading, 'Thymus gland, diseases of,' he will find listed all the books and journal articles published prior to the date of the publication of that issue of the catalogue, 1893. Under subject headings books, pamphlets, dissertations, and theses are listed first in alphabetical order by authors and are printed in Roman type. Theses and dissertations are indicated by an asterisk inserted before the title. In the case of books, the name and initials of the author are given, followed by the title of the work, size of book, place of publication, and date. The references to the articles in periodical and serial publications immediately follow the book titles and are printed in nonpareil type. They are arranged alphabetically by author, followed by the title of the paper, the name of the periodical in which it is published, place of publication of the periodical if not included in its title, year, volume, and pages in it which the article covers. The title of each book or article is given in the language in which it is printed. In giving the page numbers which each article covers an idea can be had at once of its extent.

"To get the literature published since 1892, our investigator will take volume 18 of the second series of the Index Catalogue, published in 1913, and in this series he will find the subject of 'Thymus gland' subdivided into a larger number of subdivisions, one of which is 'Thymus gland, hypertrophy of.' Under the heading, following the same arrangement as in the first series, he will find references to the literature published from 1892 to 1912 and any publications prior to 1892 which may have been omitted under the subject in the first series or acquired by the library subsequently. He now has covered the literature from the beginning to 1912. As it will be quite a number of years before the subject of 'Thymus gland' is reached in the third series, his next course to pursue in order to get at the literature since 1912 will be to take the annual volumes and current numbers of the Index Medicus.

"* * * The Index Medicus is now a quarterly classified record of current medical literature published by the Carnegie Institution of Washington. It covers the material contained in the library of the Surgeon General's Office and is made up from the same cards as are used in compiling the Index Catalogue. It appeared as a monthly publication from 1879–1920, with the exception of 1900–1902 during which it was suspended. During this period of suspension the Institut de Bibliographie of Paris issued the Bibliographia Medica, similar in character to the Index Medicus, and which filled in this break.

"Beginning with 1921, the Index Medicus has been published quarterly. Each present issue covers the entire field of medical literature for approximately three months. The material is arranged alphabetically by subjects, elaborately subdivided, closely following the classification used in the Index Catalogue. Each number in its alphabetical arrangement, forms a complete subject index for the period it covers. Shortly after the completion of each volume an Annual Index of Authors is issued.

"Now, to proceed to get our references to date on the 'Enlargement of the thymus gland,' our investigator will take the annual volumes of the Index Medicus beginning with 1913 and continuing through to 1920 and in the subject index in each volume under the heading 'Thymus gland, hypertrophy of,' he will find the names of the authors who have written upon this subject and the page number in the volume, in each instance, on which the reference will be found. From 1921 to date it will be necessary to look in each of the four numbers annually under the main heading 'Thymus gland' and subdivision 'Diseases and tumors' for the latest literature. After consulting the last number issued he has covered the most complete index that is available of the medical literature of the world."

In addition to the indexes of medical literature, there are numerous other aids to medical writing, all of which may be obtained at the library. Not the least valuable of these are the various bibliographies which have been issued as separates. Among these are mentioned bibliographies on laryngeal tuberculosis, tubercular diseases of the eye, radium, eugenics, hookworm, and carbon monoxide. Other bibliographies which have appeared in journals and books are catalogued so as to be easily found. Various publications giving abstracts in English of articles published in foreign languages are listed. In them may be found everything of value which appears in the literature.

The librarian, in a personal communication, states that a cordial invitation to make full use of the library has been extended to the medical officers of the New York Naval Hospital and that a number have already availed themselves of the privilege. Other medical officers will also be cordially welcomed, and it is hoped that whenever they are in a position to take advantage of this kind offer they will do so to their profit.

BENEFITS DERIVED FROM WRITING FOR PUBLICATION

In connection with the abstract of the article by Mr. Charles Frankenberger, librarian of the Medical Society of the County of Kings, which appears in this number, it might be well to remind

naval medical officers that not all the benefit accrues to the reader of an article, but much of it is received by the writer. The art of expressing oneself in writing is one that can be acquired only through practice, and there is no art of more value to the one who possesses it, whether he be medical man or layman.

The Surgeon General of the Army, on January 1, 1925, issued Circular Letter No. 1, inviting the attention of Army medical officers "to the importance of cultivating the art of recording in clear, vigorous English the results of their observations and experiences." His remarks are equally applicable to naval medical officers.

The BULLETIN supplies the medium through which medical officers should express their thoughts and relate their experiences concerning matters of purely naval medical interest. The Military Surgeon is anxious to secure and ready to publish contributions from naval medical officers upon subjects not entirely suited to the BULLETIN. For example, accounts of travel in out-of-the-way places, historical accounts of events or persons connected with the services in any way, or, in short, anything of historical, military, or medical interest will be accepted by this one of our service publications.

Articles by naval medical officers have been conspicuous by their absence in recent numbers of the Military Surgeon. This should not be, and naval medical officers will confer a real benefit, not only upon the periodical, but upon themselves, by contributing to its pages.

NURSE CORPS

THE NAVY'S WORK IN AMERICAN SAMOA

By C. C. KRESS, Lieutenant Commander, Medical Corps, United States Navy

The history of the development of the Samoan Hospital and Training School for Nurses is extremely interesting. From 1900, when Samoa was acquired by the United States, the facilities for the treatment of the native consisted of a building near the naval station in which were the operating room and dressing room and, in addition, there were two native houses. The medical officer was permitted to make a charge for operations but medical treatment was free. On November 28, 1910, the commandant ordered that all treatment of natives of American Samoa be free, as the Bureau of Medicine and Surgery had informed him that necessary supplies would be furnished from the Navy allotments. On April 14, 1911, the Navy authorized the erection of the present Samoan Hospital, with the provision that no charge in connection therewith would be made against the Navy.

The Samoan Hospital was built by the Government of American Samoa, with the exception of the dormitory for the hospital corpsmen, which is now used as rooms for treatment of families of officers and enlisted men and for special cases. In 1913 the hospital was completed. The nurses' home was purchased November 4, 1912, and the training school sprang into existence October 6, 1913, when the Navy nurses first arrived with orders from the Navy Department to start such a school. The school was opened February 6, 1914, with three pupils selected from the best families in Samoa, and the requirements were that they must be graduates of the Atauloma School conducted by the London Missionary Society or the Catholic sisters' school at Leone, or a school of similar requirements, where moral living and good breeding constitute one of the principal instructions.

The schools from which the Samoan nurses are selected are in themselves worthy of great consideration. The teachers of these schools are the patient, capable, long-resident missionaries who have, since 1830, so faithfully inculcated the principles of Christianity, and brought the natives out of the stone age. One of the Atauloma teachers suffers with great pain at times from filariasis of the arm, yet she goes right on with her work as soon as the attack is over. A sister at the sisters' school at Leone who has been teaching there for

35 years, is now disfigured with elephantiasis, yet only complains that the public-school system, with which this school has recently become affiliated, requires too many schoolbooks as compared with the simple but effective schedule she was accustomed to. A sister at the sisters' school across the bay is so broken down with neuritis and a chronic eye condition that she is nearly blind, yet stays nobly at her work with the children, with only death to relieve her from her suffering.

The first class of the training school was graduated on February 21, 1916. Feiloaiga, Pepe, and Initia completed the course. These three women have made exemplary rôles for themselves. Feiloaiga is married to a Samoan pastor and living in the Gilbert Islands; Initia is married to a Samoan pastor and living in New Guinea. These two do no active nursing, but their advice and aid is sought for at times and great good is accomplished. I recently met Initia and had a most delightful talk with her. Her pleasant manner and her good English made her a very attractive person to converse with. Pepe, our model nurse, is still on duty at the hospital; she had a year's training at the Mare Island Hospital and an article written by her has been published by the Surgeon General in the UNITED STATES NAVAL MEDICAL BULLETIN.

On January 21, 1915, the Navy Department approved the institution of the outlying dispensary system, and on March 1, 1915, hospital corpsmen and supplies for the same arrived. In 1921 the chain of dispensaries was made complete.

The Samoan Hospital Training School and Nurses' Home building has recently been completed, and now the Navy nurses have the nurses' old home to themselves and all the personnel are much happier and more comfortable.

I have attended many unusual affairs in my varied medical experience, but few have left so vivid an impression as the graduating exercises of the Samoan Hospital Training School on January 9, 1924. This was the seventh graduating class since 1914, the year of the opening of the school, and when these four graduates received their diplomas there were just 23 graduates of the training school for the 10 years' work, which shows the difficulty of obtaining such distinction.

The course of the training school is three years. The pupil nurses are supplied by the government of American Samoa with uniforms, board and lodging, and are paid $2.50 per month. The graduates receive their uniforms, board and lodging while in the employ of the government, and are paid $15 per month, with $1 additional for each year's service, and retirement in 10 years at $5 per month. On duty in the hospital, but housed in the training-school quarters, are five graduates, while out on the districts are

five other graduates. The duty at the hospital is eight-hour duty, the night duty receiving extra pay. One graduate nurse is in charge of a ward or native house, under observation of the Navy nurses, and is assisted by three or four pupil nurses. At the training school classes are held by the Navy nurses two hours in the morning and one hour in the afternoon, the subjects being English, anatomy, physiology, materia medica, obstetrics, and practical nursing. The nurses are taught to keep house, to prepare diets, and arrange bedside trays. They have been of incalculable service in the private home, attending families of the Navy personnel.

In connection with their district work, they are taught the use of disinfectants and handling of contagious disease and its recognition, and instruction of the people for self-protection; also the instruction of the mother in the care of the baby. They have done excellent work in assisting in taking the annual medical census of the entire population. The district nurse is the public-health nurse and her work in the public health and social service is of inestimable value.

The duty of the Samoan nurse out in the district has just been changed from six to two months, as it was found that they lost their fluency in English if they remained away from the hospital longer. Radio communication is now perfected with the Manua Islands, 70 miles east of the island of Tutuila, so that the three Samoan nurses on district duty there can now secure aid. There has always been a taboo on women in Samoa which is gradually becoming lost through education and contact. At one time a woman could not even step into a canoe. This makes it difficult for the district nurse to get the people to do as she says, as they are not accustomed to taking a woman's advice. However, the nurses are happy, and happy and contented nurses make happy and contented patients, as there is a most constant association between nurse and patient.

The confidence of the natives is best gained through the medium of their own people, through the Samoan nurse on the district. As with the Filipinos, the Samoan nurse is naturally quiet, gentle, and friendly. She is nonirritable and inherently courteous. This urbanity of the Filipino is derived partly from long association with the Spanish. In the case of the Samoan, I feel that it is an heirloom of an ancient grade of civilization. By the mercy, kindness, and gentleness of these women will the physical betterment of the Samoan race be accomplished.

The Samoan Hospital Training School is a school of high standard and as instructors here, the Navy nurses' duty lies in raising the standard of nursing in Samoa. Their duty lies in showing the Samoan

the value of the education which the Samoan nurse receives at the training school and in showing the Samoan the benefits he derives through intelligent nursing and better care which he receives at the hands of the Samoan hospital and the Samoan nurse.

The Navy chief nurse is superintendent of the hospital, superintends clinics, operations, and dispensing of medicines, supervises the work of the Navy nurses, as well as the work and instruction of the Samoan nurses in the training school and the district nurses. There are also attached to the Samoan hospital two Samoan hospital corpsmen (Navy) and one apprentice seaman, enlisted in the Fita Fita Guard for medical duty only. The chief nurse submits monthly reports from the hospital and makes requests for stores and supplies for special diets, for keeping house at the Navy nurses' home, and the Samoan nurses' home, a delicate detail, requiring great tact and control to keep these women interested, instructed, and, withal, happy. The Navy is responsible for the health and moral welfare of the Samoan nurse while on duty for the Samoan Government. Discipline is therefore very carefully guarded; at the same time the nurses are kept occupied and as comfortable as possible. Their own separate home, with large dormitory, liberal locker space, dining, kitchen, and toilet accommodations, goes a long way toward contentment. They have left a life of assured ease and freedom to take up this three years of toil and discipline, showing thereby that they have the divine spirit of sacrifice and service to their fellow men.

There is almost as much need for the male corpsmen as for the female nurses, as they are invaluable for duty about the hospital, operating room, and at the outlying dispensaries. There should be a future for the male Samoan in nursing as an impetus to get better work.

The principal diseases which the nurse in Samoa is called upon to take care of are yaws, conjunctivitis, filariasis, worms, and tuberculosis, all easily controlled and cured except filariasis and tuberculosis. Occasionally a contagious disease, such as the exanthems, comes into Samoa by way of oceanic travel, but vigorous quarantine activity by the medical officers has kept out most of it. Influenza was prevented from coming here, the only island not visited by deadly destruction in 1918–1920. Measles played havoc here in 1904 and 1911. All the natives are carefully vaccinated against smallpox. Dysentery of the bacillary type, quite fatal to children and infants, had spread over entire islands when I arrived there and it kept everyone very busy for three months. Considerable surgery is done at the Samoan hospital and the X ray is available for all but chest

and pelvic examinations. The results in surgery are uniformly good, owing in part to the rareness of infection among Samoans.

Now that the Samoan is beginning fully to appreciate his hospital, maternity cases are coming in for confinement, which gives considerable experience in that line. This, with the abundance of material in diseases of women and children caused by carelessness and neglect out in the villages, filthy attempts at midwifery, and crude habits, gives a wide range of interesting medical work not confined to the Tropics. Two cases of leprosy were treated with acid esters of chaulmoogra oil and paroled to their homes under observation after one year's treatment.

The climate at the beach, because of the surrounding high mountains and the humidity from high rainfall, is very oppressive.

There have been many interesting cases of tuberculosis. A village for the segregation of these cases has been urgently requested, and the Navy Department is seriously considering the plans which have been submitted. This would be the first time an attempt has been made to stop the inroads of this plague by segregation of the cases. The disease is spreading as civilization spreads among the natives, the lack of resisting power being due to its being a new infection and to the natives adopting European clothing and habits.

The Samoan is still a child, undeveloped. A noble race, with customs and traditions which show a previous high grade of civilization. He is just 90 years out of the stone age, which accounts for many of the incongruities in his character. When we stop to think what the European was like 90 years from the stone age, we can see the progress of the Samoan. A slave of precedent, tradition, combined with the teaching of the missionaries, rigidly guides his simple life. He is a Christian, with slight latent expression of the heathen element. His Christianity has been slowly inculcated by years of work on the part of missionaries. He is slow to adopt new ideas but not awed by them. One member of each family, the unit of life in Samoa, is believed to have powers to heal according to their traditions, and the Samoans like to take medicine and treatment. He readily consults his native "doctor," who gives massage, applies inunctions, or gives, internally, decoctions of native herbs. This desire to take medicine is a good thing, as it brings the native in for his 606 for yaws, and he highly prizes this medicine. He comes in readily for his worm treatment, and it is with great difficulty that the district nurse makes her supply of castor oil and salts cover the allotted territory. If he could only be taught to come to the hospital or dispensary direct instead of first going to his Samoan adviser! About 25 deaths each year are caused by Faa-Samoan treatment. The Samoan is beginning to be enlightened, and the good

work of education of the younger generation in the 19 public schools over Samoa, which are well attended, is being seen in the increased attendance at the government medical establishments.

As mothers of the future race of Samoans, the women are surely fine specimens of humanity. With their undeveloped state and faulty customs corrected, great strides could be made toward the upbuilding of the race. In Samoa the woman is faithful to her home, which the Samoan holds in great respect. Hospitality is at its truest form in Samoa, and the few strangers that get in there have not stamped it out by imposition. The Samoan mother needs much enlightening in her own care during child bearing, and her habits in the care of the child are responsible for much loss of life. The district nurse is performing great service in teaching the mother the simple rules of care of herself and child, which will save the life of many an infant. We teach the Samoan nurses at the hospital and they in turn teach the mothers. They are taught, when weaning the baby, to put it on a condensed-milk formula and not to give it solid foods like taro and bananas until it is almost a year of age. Condensed milk with small quantity of cocoanut juice or cottonseed oil to bring up the full percentage, and juice of the native orange, make a very satisfactory feeding for the Samoan infant. Later a soft diet of Samoan foods specially prepared can be used to amplify the milk, such as mummy apple or banana soup, arrowroot, rice or oatmeal gruels, and fresh milk from cows, if available. In teaching the Samoan nurse the preparation of special diets, attempt is being made to make use of the native materials in preparing suitable dishes for the sick. There are some 50 native dishes, only four or five of which are fit to feed a sick person.

During the years 1921, 1922, and 1923, there were 774 births and, of these, 158 infants less than 1 year old died; in other words, 20½ per cent of all babies died within their first year. In the Philippines the infant mortality is greater—33⅓ per cent of all births. With these figures in mind, it is easy to see that greater effort is needed and more encouragement for the nurses in their public and social service work.

Such are the people of Samoa and the diseases which the Navy nurse is called upon to care for. This duty is pioneer in character among a native people of peculiar disposition and traits. Optimism is needed in the work of teaching the native nurses, as anyone with experience will tell, for it requires tireless patience and tact to get the natives' point of view and to hold their interest. To take this raw material, able to understand but very little English, and teach them new and unusual subjects, one has a large undertaking ahead, always remembering that these natives are slaves of precedent and

accept radical changes with suspicion. It is a great opportunity to do good among a backward nation which is ready and in need of it. With the proper spirit and an open mind, the good that can be done thrills one with the feeling that here, at least, one's work will show results. It is such a small place that an individual's importance becomes magnified, and so isolated that each person's duties not only assume a new importance but new and unusual things come which have to be done, and you do them. Your doing things shows results, and you are then called upon for advice and help in your new rôle as well as in your old. There is a great deal of varied medical and surgical experience, differing in character. The hospital is a most unusual institution, differing from anything ever seen anywhere. It soon grows on one until it stands out as a very nearly perfect institution for this work, and it is considered the best in the South Seas. People who are able come from the islands around Samoa and consider themselves fortunate. The naval station is much like any other station, having a native band, and its social functions, with about 25 Navy people at the large affairs. The nurses love their home, nestled up among the trees well up the slope from the main road and giving a splendid view of the whole station and the harbor, and affording a quiet, secluded spot for reading and rest.

In Samoa there are no harmful animals. A few centipedes with which people are seldom bothered, and no snakes. Hiking over the mountains is very pleasant and there is excellent swimming in the clear buoyant water of the bay. Nature's beauties abound here in profusion. Considerable interest has been aroused at the Samoan Hospital in raising vegetables in a garden at the back of the nurses' home, and experimenting with native fruit trees and flowers. A great deal has been started during the past year with the aid of the officer detailed to agricultural experiment and with a gift of many seeds and slips from Hawaii by Commander Houston and Doctor Wilbur of Honolulu. Chaulmoogra trees have been well started and some day they will cure a Samoan leper, as we have seen two Samoans cured in the past year at the Samoan Hospital. It is hoped to supply the hospital and nurses at some near future date with coconuts, bananas, taro, breadfruit, oranges, and vegetables from the things raised right in the hospital grounds, which cover some 15 acres. The dairy is an interesting institution and has been built up, in spite of most serious obstacles, to a point where the needs of the hospital and naval station are well supplied with good milk. All the feed for the cows is obtained from Australia, as the pasture is too rocky and steep for grass to grow.

The climate is generally hot, but, by adaptation and slowing down a little from the American pace and manner of living, there will

be a struggle only during January and February. The nights are always cool. When it rains it is cool—quite different from the Philippines. I have been much more uncomfortable in August in Charleston, S. C., than here in February. It is delightful here from May to November when the trade winds blow steadily. The sun is always hot and the flies stick to one badly in the woods, but flies and mosquitoes are not noticeable in the well-cleared area. One can sit out under the trees at night and rarely ever notice a mosquito. Odd and delightful conditions and surroundings among an odd and interesting people; a long way from home on an isolated island, very much shut in, and mail steamers only once in three or four weeks. It is a wide travel experience to have visited the South Seas, with opportunity of visiting Australia and New Zealand for a short time. But we can well afford in the Navy to sacrifice a few so-called luxuries for the benefit we can bring to our less enlightened, less fortunate human beings—the Samoans.

BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,
United States Naval Medical Bulletin,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.
(For review.)

Facts on the Heart, by *Richard C. Cabot, M. D., Professor of Medicine and of Social Ethics at Harvard University.* W. B. Saunders Co., Philadelphia, 1926.

The facts stated in this book are based on the necropsy records of 1,906 cases. In this respect the book is unique. There is little about treatment, the text being almost completely given over to symptoms, diagnosis, prognosis, and pathology of heart disease.

In the preface the author gives the following rather startling advice: " Very few people should even try to read the whole of this book. I should advise most readers to read the opening and the closing chapters, and the summaries at the end of each section, and then to look over as many of the illustrative cases as seem interesting."

After reviewing this book, it would appear that the above advice is sound and will no doubt be followed by the average reader.

In his opening chapter the author states that the first and, in some ways, the important point is to keep in mind the fact that most heart disease is imaginary.

The most frequent cardiac lesion was found to be simple hypertrophy and dilatation (or hypertensive cardiovascular disease) which constituted 77 per cent of the cases reported.

Over 90 per cent of all cases fall under the head of the three types called hypertensive, syphilitic, and "rheumatic."

Acute and subacute endocarditis made up a little less than 10 per cent of the series.

Of the three main types of heart disease, the rheumatic usually begins in early youth and the hypertensive after the fiftieth year, while syphilitic heart is commonest between 35 and 45. Heart disease in a young woman is almost always rheumatic (mitral ste-

nosis). In the middle-aged man, without rheumatic history, a valvular lesion is apt to be due to syphilitic aortitis, producing regurgitation at the aortic valve. In the elderly man, previously free from heart trouble, circulatory disease is usually of the hypertensive type.

The author states that the "fashionable diagnoses," such as myocarditis and mitral regurgitation, are both rare types and not clinically recognizable.

Over half the cases of mitral diseases are not recognized in life. The author believes recognition would be more frequent if physicians realized that the characteristic mid-diastolic or presystolic murmer is not always to be heard unless one takes special measures, such as exercise, amyl nitrite inhalation, special positions of the body, or auscultation at different times of day, which may bring out this particular type of murmur.

Syphilitic heart disease was six times as common in men as in women and there was no evidence that the disease attacked any valve but the aortic. Angina pectoris was a common feature of syphilitic heart disease. It occurred in association with narrowing of the coronary orifices and also without any demonstrable change in these orifices or in any part of the coronary arteries. The Wassermann reaction was positive in at least 80 per cent of cases of syphilitic aortitis.

Under the heading of hypertensive heart disease the author groups all cases of enlarged heart without valve lesions of chronic pericarditis. He believes that hypertension resulting in cardiac enlargement and final cardiac failure is a common disease independent of any nephritis or arteriosclerosis. In many of these patients cardiac failure never occurs at all, and the patient dies of some other disease or of some extracardiac manifestation of hypertension, such as cerebral hemorrhage.

Acute and subacute endocarditis are usually caused by some type of streptococcus and appear to attack both sexes equally, especially young adults. The mitral valve is affected in over three-fourths of the cases. Clinically the disease is recognized when symptoms of sepsis, such as fever, leucocytosis, chills, anemia, jaundice, or bacteriemia, are combined with evidence of a valvular lesion and of embolism.

In thyroid intoxication, congestive failure may occur but no constant post-mortem cardiac lesions were found.

Angina pectoris has no constant anatomical basis. Coronary disease and macroscopic changes in the aortic arch are often absent in cases of angina pectoris and still more often present without angina.

This book is a good illustration of the growing tendency to apply the statistical method of investigation to medicine. The author's careful analysis of the statistical data presented makes this a valuable addition to any medical library.

ELECTROTHERMIC METHODS (DESICCATION AND COAGULATION) IN THE TREATMENT OF NEOPLASTIC DISEASES. Designed as a Practical Handbook of Surgical Electrotherapy for the Use of Practitioners and Students. By *J. Douglas Morgan, B. A., M. D., formerly Radiologist, Ross Pavilion, Royal Victoria Hospital, Montreal; Instructor in Radiology, University of Pennsylvania Graduate School of Medicine, Philadelphia, Pa.; Member of the Roentgen Society, London, England; Fellow of the Royal Society of Medicine, London, England; Member of the American Röntgen Ray Society; etc.* F. A. Davis Co., Philadelphia, 1926.

In spite of the great numbers of articles written on the electrothermic methods in the last few years, our knowledge of them is very limited. We have only scratched the surface so far and years of careful study and experimentation will be required before we are able accurately to evaluate them. Just at present there is a great deal of widely circulated misinformation, emanating chiefly from manufacturers and salesmen of high-frequency machines which is certain to cause an unfavorable reaction when the inaccuracy of the claims is recognized. There is great confusion in the nomenclature, each enthusiast coining new orthological obstacles to clarity of understanding.

This little book has many virtues. In the first place, it is written by a man of scientific training; a clear thinker and close observer who has had years of intimate association with those who have done most to develop our knowledge of the subject. In the second place, the complicated terminologies are harmonized so that the literature can be clearly understood. In the third place, it is a clear and accurate presentation of the practical value of these methods.

Observation of the use of the electrothermic methods in two of our naval hospitals makes it clear that before long they will be in use in all our hospitals and a knowledge of them will be an essential part of the surgeon's equipment. It is a pleasure to recommend this book as a safe and practical guide to this knowledge.

EMERGENCY SURGERY, The Military Surgery of the World War Adapted to Civil Life, by *George de Tarnowsky, M. D., F. A. C. S., D. S. M., Colonel, M. C., O. R. C. (378th Medical Regiment), Professor of Clinical Surgery, Loyola University Medical School; Attending Surgeon, Ravenswood Hospital, Chicago; Attending Surgeon, Cook County Hospital 1913–1919; Author of Medical War Manual No. 7, Military Surgery of the Zone of the Advance.* Lea and Febiger, Philadelphia, 1926.

It is to be doubted that any two surgeons could be found who could agree on the material that should be included in a book on

emergency surgery. So far as the present volume is concerned, one may express the opinion that if the contents were considerably reduced and the title changed to "Digest of Publications of the Medical Department, U. S. A.," it would be a better book and its classification would be a simpler matter. There is a haunting familiarity about much of the text and many of the illustrations, which is explained when we read the preface. The author of this book was, in 1917, commissioned to write "Military Surgery of the Zone of the Advance," and much of the material that we labored over in 1917–18 is here.

One of the best parts of the book is the recommendations for choice of procedure in the case of certain injuries. These were subjects of study by Army boards and their conclusions, based on great numbers of cases, are of great value.

It is difficult to determine the particular niche into which this book should fit. If one could have but a single book on surgery, this would certainly not be it. If one could have three or four books, he would not need this one.

MODERN METHODS OF AMPUTATION, by *Thomas G. Orr, A. B., M. D., F. A. C. S., Professor of Surgery, University of Kansas.* The C. V. Mosby Co., St. Louis, 1926.

The need for standardized technique in amputations is recognized by all surgeons, particularly military surgeons. The object of amputation, aside from its value as a life-saving measure, is to give the patient a useful, functional stump, that will serve as an attachment for an artificial limb in as short a time as possible. The author of this book describes briefly, but in sufficient detail, the methods which he has found most useful and which he considers as worthy of adoption.

The classical foot amputations, except those of Lisfranc and Syme, are condemned as of no value.

Cinematiplastic amputations are discussed and described and the author evidently recognizes their worth.

The fitting and description of artificial limbs are given considerable attention and a plea is made for greater cooperation between the surgeon and the limb maker and for early, proper fitting.

The illustrations, largely photographs, are excellent.

DISEASES OF THE SKIN, by *Richard L. Sutton, M. D., LL. D., F. R. S. (Edin.), Professor of Disease of the Skin, University of Kansas School of Medicine; Assistant Surgeon, U. S. Navy (ret.).* Sixth edition. C. V. Mosby Co., St. Louis, 1926.

In the January, 1924, number of the UNITED STATES NAVAL MEDICAL BULLETIN there was a review of the fifth edition of this book. It would hardly seem possible that the advances in the field of cutaneous dis-

eases would warrant the changes to be found in this sixth edition. The author has endeavored to eliminate many of the obsolete views which modern methods of investigation warrant. The remarkable pictures, the concise descriptions of the diseases, and the complete bibliography are still outstanding features of the book. As a former medical officer of the Navy we are especially interested in the success that the author has achieved, not only as a teacher of dermatology, but through hard work and sound judgment, he now has an *international* as well as *national* reputation. It is hoped that some of our medical officers may be inspired to devote special study to this subject, for there is a field of opportunity for such a special qualifications in the Navy.

SWANZY'S HANDBOOK OF DISEASES OF THE EYE AND THEIR TREATMENT, edited by *Louis Werner, M. B., F. R. C. S. I., Sen. Mod., University of Dublin.* Thirteenth edition. P. Blakiston's Son & Co., Philadelphia, 1926.

Swanzy's Handbook is an excellent book for the student, the general medical man, and even the ophthalmologist. It has been a standard British textbook for more than a generation.

The book first takes up the ophthalmoscope and the findings in a normal fundus. Following are chapters given over to diseases of the conjunctiva, cornea, sclera, iris and ciliary body, the lens, the vitreous humor, the choroid and retina, and the optic nerve. Separate chapters are devoted to diseases and symptoms liable to accompany focal diseases of the brain, organic diseases of the brain, and diseases and injuries of the spinal cord. Refraction, and orbital muscles and their derangements, are discussed at some length.

The book is well written and quite comprehensive. It would be a valuable addition to a ship's medical library.

COLLECTED PAPERS, by *The Staff of the Henry Ford Hospital.* First series, 1915–1925. Paul B. Hoeber (Inc.), New York, 1926.

As indicated by its title, this book contains the papers published in various medical journals by members of the staff of the Henry Ford Hospital during the 10-year period 1915–1925. A wide range of subjects is covered and many of the papers are of considerable value. Among the subjects discussed are: Blood phosphates, heart block, hemophilia, the psychoneuroses, blood transfusion, insulin, tannic acid in the treatment of burns, and many other.

In addition to the medical papers, descriptions of useful devices and a history of the hospital are included.

While this collection of papers will be of greatest interest to members and former members of the staff of the Henry Ford Hospital, others will find the book worth reading.

INTERNATIONAL MEDICAL ANNUAL, 1926. **William Wood & Co., New York.**

For 44 years this annual has occupied a leading position among the many publications of similar character. Its contributors, most of whom are British, are men of high standing in their profession and are well qualified to differentiate the wheat from the chaff in the literature which appears annually concerning their chosen branches of medicine. For this reason, the reader of this annual may feel assured that he is getting a good summary of all the advances made in medicine during the year under consideration. The literature of the world is covered and there are many references to American writings.

It would be an impossibility to review such a book adequately in a short space, but it may safely be stated that anyone who wishes to keep abreast of the times in medicine would do well to possess this book for study and reference.

MODERN MEDICINE, edited by *Sir William Osler, Bart., M. D., F. R. S.* Third edition, thoroughly revised. Re-edited by *Thomas McCrae, M. D.*, assisted by *Elmer H. Funk, M. D.* Volume III. Lea & Febiger, Philadelphia, 1926.

Diseases of metabolism and diseases of the digestive system are discussed in this volume of Osler's System. As many of the greatest and most far-reaching discoveries of recent years have been in connection with the diagnosis and treatment of these conditions, many additions to and changes in the text have been necessary in this edition. These have been made and the volume now contains all that is known to date concerning these frequent and often obscure diseases.

HANDBOOK OF DISEASES OF THE RECTUM, by *Louis J. Hirschman, M. D., F. A. C. S., ex-chairman, Section on Gastro-enterology and Proctology, A. M. A.; ex-president, American Proctologic Society; Professor of Proctology, Detroit College of Medicine; Proctologist, Harper and Woman's Hospitals; Detroit, etc.* Fourth edition, revised and rewritten. The C. V. Mosby Co., St. Louis, 1926.

Some day some one will write a complete and satisfactory one-volume work on diseases of the rectum and anus, a book to which the general practitioner and general surgeon can turn for help when needed. So far as the reviewer knows, that book has not yet been written. The present volume does not quite fill the specifications, though it comes nearer to that goal than any other he has recently seen. The fact that it has survived to a fourth edition is evidence of its very considerable merit.

Most of the book is concise, thorough, and practical, the chapter on dysentery being the conspicuous exception. Local and sacral anesthesia are covered in an excellent manner. The book would be a distinct asset to the library of a naval hospital.

A CLASSIFICATION OF THE TUMORS OF THE GLIOMA GROUP ON A HISTOGENETIC BASIS WITH A CORRELATED STUDY OF PROGNOSIS, by *Percival Bailey and Harvey Cushing.* From the surgical clinic and laboratory of the Peter Bent Brigham Hospital and the laboratory of surgical research of the Harvard Medical School, Boston, Mass. J. B. Lippincott Co., Philadelphia, 1926.

Some years ago the authors began an investigation of these tumors, endeavoring to answer the following questions: (1) What is the basis of the structural variability shown by these gliomatous tumors? (2) Has their histological variation any clinical significance? (3) Does it account for the unexpectedly long survival period, or even cure, after extirpating certain of them?

The monograph giving the results of these studies includes a classification of the gliomata, a brief discussion of the origin of brain tumors, and a chapter on the clinical application of the established facts.

THE CLINICAL INTERPRETATION OF THE WASSERMANN REACTION, by *Robert A. Kilduffe, A. B., A. M., M. D., Director of Laboratories, Atlantic City Hospital; City Bacteriologest, Atlantic City; etc.* Lea & Febiger, Philadelphia, 1926.

This little volume largely represents a collection of articles published by the author during the past several years on the virtues and interpretation of the Kolmer-Wassermann test. Since the naval service has found it necessary to abandon this test after several years' trial, naval men will find little in this volume of especial interest to them.

It may be noted that the Kahn test receives but cursory mention. The author apparently refuses to give this test a careful trial in spite of the fact that he requires a serologist to be "open-minded," and of the additional fact that Doctor Kolmer, whose disciple the author claims to be, uses the Kahn test as a routine procedure parallel with his Wassermann test.

The value of a book of this type is very doubtful, since it is practically useless as a guide for the serologist, and the clinician and syphilologist will find nothing not already presented in standard works on syphilis.

NURSERY GUIDE, by *Louis W. Sauer, Ph. D., M. D., Senior Attending Pediatrician, Evanston Hospital.* Second edition. The C. V. Mosby Co., St. Louis, 1926.

A practical guide for young mothers and nurses which will be of real value. It is simply written, and therefore its advice is easily understood and more likely to be followed than if it were hidden in a mass of scientific detail.

The common physical problems of infants and children of preschool age are dealt with.

THE DIVISION OF PREVENTIVE MEDICINE

Lieut. Commander J. R. PHELPS, Medical Corps, United States Navy, in charge

Notes on Preventive Medicine for Medical Officers, United States Navy

THE NAVY RATION FROM THE VIEWPOINTS OF NUTRITIONAL SCIENCE AND PRACTICAL ADMINISTRATION—Continued

By J. R. PHELPS, Lieutenant Commander, Medical Corps, United States Navy

PART III

METHODS OF STUDYING METABOLISM

The student of metabolism has recourse to the following methods:

1. Listing of all food ingested in a given period of time—quantity and chemical composition.
2. Collection of excreta and determination of total nitrogen eliminated.
3. Determination of the quantity of carbon dioxide eliminated by the lungs.
4. Record of the quantity of oxygen inspired.
5. Determination of the quantity of heat liberated by the body during the observation period.
6. Record of changes in the weight of the subject or experimental animal.
7. Record of body temperature.

For the purpose of this article it is necessary to refer only in a general way to the methods employed. The medical officer should have a general idea of the kind of work required for the extension of knowledge in this field of science, but those having special interest will of course consult the voluminous literature. Lusk in his Science of Nutrition discusses the principles of experimental study in sufficient detail to meet the needs of most students. Other books useful for reference are, Basal Metabolism in Health and Disease, DuBois; Chemistry of Food and Nutrition, Sherman; and Principles of Biochemistry, Robertson.

The quantity of heat liberated by the body may be measured by the *direct* method or calculated by the *indirect* method which consists in determining the quantity of oxygen absorbed and estimating

the number of calories released through oxidation changes within the body.

For complete and accurate study the elaborate respiration calorimeter is required. Such apparatus includes a chamber large enough to afford the subject within some freedom for the play of his muscles. The apparatus in its modern form is the Atwater-Rosa respiration calorimeter, with improvements added by Benedict, Williams, and others, which make for greater precision in measuring heat, carbon dioxide, and oxygen.

The apparatus is so constructed that no heat can escape without being transferred either to circulating water of known quantity, the temperature of which is accurately measured, or to sulphuric acid through which the expired air is passed to remove water vapor given into the air by the lungs and skin. Lusk states that roughly speaking one-quarter of the heat eliminated by a man in the chamber is present in the water vapor thus absorbed by the acid. This water is weighed. At 20° C. (68° F.), 0.586 calories are contained as latent heat in 1 gram of vaporized water. The evaporation of 1 gram of water at 0° C. requires 0.5967 calories; at 100° C., 0.5366 calories.

The gaseous exchange is determined by weighing the quantity of oxygen which is delivered from a tank and automatically fed into the recirculating air to maintain the proper percentage for breathing. The principle is not unlike that of the simple method of recirculation employed with the Navy type of rebreathing apparatus. The air within the chamber is purified by drawing it out through a leak-proof system of tubes and forcing it by means of a rotary blower through a series of absorbers. The exhaust air passes first through a container of sulphuric acid to remove the water; then through moist soda lime to remove the carbon dioxide, and, finally, through sulphuric acid to remove the moisture absorbed from the soda lime, after which it is automatically enriched with oxygen to restore the volume and barometric level and is then delivered back to the respiration chamber.

According to Lusk, the device for measuring the consumption of oxygen is so sensitive that if a person in the calorimeter moves even an arm during the critical moments at which hourly readings are taken the increased local heating of the air may cause the spirometer to rise to a considerable height, of which the air thermometers inside the chamber make compensatory record so gradually that the oxygen determination for that hour will be too low and for the next hour too high.

Lusk states that the original Atwater-Rosa apparatus, without the advantages of more recent modifications and developments, was technically so perfect that the heat generated by an electric current

could be measured as 100.01 per cent of the actual value. When a known quantity of alcohol was burned (alcohol check) the carbon dioxide recovered amounted to 99.8 per cent and the heat to 99.9 per cent of the theoretical values.

CALORIMETRY

Direct calorimetry involves the use of the respiration calorimeter referred to above.

Indirect calorimetry means the calculation of heat produced, from knowledge of the gaseous exchange. In the complete experiments made with a subject in the chamber, although the heat produced is measured directly, the number of calories is also calculated, as a rule, in this indirect manner to check against the direct measurements.

Clinical apparatus for determining the patient's rate of metabolism during limited periods of time—usually six-minute periods—is designed for indirect calorimetry. As a rule the calculations are based entirely on the quantity of oxygen consumed by the patient. The observer seeks to estimate the rate of basal metabolism. The method appears to be reliable enough for certain clinical purposes, but several assumptions are involved. The first is that the patient's physical and mental states are consistent with basal conditions during the brief periods while the consumption of oxygen is being determined. The second assumption is that the respiratory quotient is approximately what it is assumed to be. For the purposes of clinical calorimetry the R. Q. is ordinarily assumed to be 0.82. It may be above or below that value depending upon many conditions, including the proportionate quantities of nutrients being metabolized at the time and the effect of recent muscular exertion. In diabetes the respiratory quotient may be under 0.70. If carbohydrate is being converted into fat at the time, the respiratory quotient may be higher than 1.00. However, these considerations merely indicate the importance of careful clinical and laboratory study of the patient, his habits, his diet, and his excretions, especially the urine, in connection with calorimetry. With complete knowledge of the case it is not likely that a probable deviation from the assumed respiratory quotient will be overlooked.

DuBois remarks in his book, Basal Metabolism in Health and Disease, "There is a tendency at the present time in some hospitals to turn over the management of the metabolism laboratory to a technician who has had no training in medicine or the science of nutrition. Such people often do well in metabolism work just as in Röntgen-ray diagnosis or bacteriology. On the other hand, they can scarcely be blamed if they get far off the track and make disastrous errors." He points out that the management of experiments

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and interpretation of results should be in the hands of a clinician who has made special study of metabolism. In order that he may be on guard against all possible errors he must be familiar with the technique. According to Benedict, knowledge of the extent to which body temperature, skin temperature, exposure to a cold environment, sleepiness, and psychic unrest may affect basal metabolism is as yet uncertain, but Benedict seems to have demonstrated that prolonged rest in a hospital bed prior to determining the rate of basal metabolism in the morning is not necessary. According to Benedict's observations, under conditions in which excessive chilling or shivering is not induced, heat production is independent of transitory heat loss. Considerable amounts of heat may be stored in or lost from the peripheral tissues without materially affecting heat production. In the case of normal persons, at least, the exercise of rising, bathing, dressing, walking, etc., is without influence on the rate of basal metabolism as determined on any certain day, provided a period of absolute rest for one-half hour is insisted upon prior to the test. (Ed., J. A. M. A., 85:23). Laboratories and clinics ordinarily permit patients to come from their homes in the morning. The journey involves varying amounts of exercise and exposure, but the overnight hospital regimen no longer seems to be requisite. A 30-minute period of complete muscular repose, with the subject lying on a comfortable bed, well clothed and lightly covered, should always be insisted upon.

Various forms of apparatus for determining the rate of basal metabolism under the conditions contemplated above are on the market. Some are portable and some are semiportable. In the use of some, provision is made for collecting and weighing the carbon dioxide exhaled, but more often only the quantity of oxygen consumed is measured or weighed, it being assumed that the respiratory quotient is 0.82 fourteen hours after the last meal, and that the caloric value of 1 liter of oxygen consumed with that quotient is 4.825 calories. This value is sufficiently accurate for clinical purposes but does not take into consideration the probability that about 15 per cent of total calories are derived from protein, in which event a liter of oxygen used would have a value of 4.78 calories with a respiratory quotient of 0.82. Du Bois states that in basal metabolism experiments in the calorimeter respiration chamber the quotient is usually between 0.80 and 0.84 but may be as low as 0.78 or as high as 0.90, and that the value for oxygen may be anywhere between 4.7 and 4.9 calories per liter.

Abnormal increase in the rate or depth of breathing during the course of the few minutes for which the amount of oxygen consumed is measured can readily introduce a large error into the calculation of heat production. Du Bois states that next to leaky ap-

paratus this has caused more trouble than any other factor. With properly designed apparatus and proper technic it is, of course, possible to avoid this.

At the United States Naval Medical School the Benedict-Roth, a modification of the Benedict portable metabolism apparatus, is used. In this model respiratory valves take the place of a motor blower, so the likelihood of mechanical troubles involving leaks is reduced to a minimum. It is equipped with a chronokymograph. Heat production is calculated solely from the amount of oxygen consumed during the observation period—a representative six-minute run. During the run the frequency and depth of respirations as evidenced by movements of the spirometer are graphically recorded by the kymograph and correlated with the movements of a time tracer on a sheet of paper attached to a revolving drum. Before concluding the test graphic proof of the presence or absence of a leak is obtained by placing a weight on the spirometer bell. If there is a leak the increased loss of oxygen will be evidenced by a rise in the oxygen line on the graphic record. The apparatus is so constructed that the volume of oxygen can be measured with quite sufficient accuracy, and the correctness of the volume figure can readily be checked by measuring the circumference of the spirometer bell at several points. Thermometric and barometric readings are made and the volume of oxygen used is expressed as volume under standard conditions of temperature (0°C.) and pressure (760 mm. of mercury).

Estimated calories=Vol. (liters)$\times$4.825. The result is multiplied by 10 to obtain the hourly rate and finally expressed as calories per square meter of body surface per hour. Two or more six-minute runs are usually made in the course of the test in order that a fair sample may be selected for the arithmetical calculations.

For more accurate and complete studies in metabolism, and especially for research work, direct calorimetry is required. The most accurate results are obtainable with the Atwater-Rosa-Benedict type of respiration chamber calorimeter because the metabolism can thus be measured by two independent methods, direct and indirect, and the determinations may be made to cover prolonged periods of observation if desirable. Oxygen consumption can be measured accurately with the Benedict-Roth apparatus and other types, but an error amounting to as much as 2 per cent of the calculated heat production may result from the assumption that the undetermined respiratory quotient is 0.82.

Lusk describes the method of using the Atwater-Rosa-Benedict chamber respiration calorimeter in an interesting way. The following data are or may be used:

One gram of nitrogen in the urine is taken as an average to represent protein destruction in the body yielding 26.51 calories.

This assumption makes allowance for a certain amount of nitrogen excreted in the feces.

The amount of protein corresponding to 1 gram of nitrogen in the urine requires 8.45 grams of oxygen for its oxidation and 9.35 grams of carbon dioxide are thereby formed.

One gram of oxygen is equivalent to 0.699 liter. One gram of carbon dioxide is equivalent to 0.5087 liter.

The quantity of carbon dioxide resulting from the oxidation of protein can be deducted from the total carbon dioxide collected; urinary $N \times 9.35$ grams. The quantity of oxygen involved in the destruction of protein can likewise be deducted from the total consumption of oxygen—urinary $N \times 8.45$ grams.

From the remaining quantities of oxygen and carbon dioxide the respiratory quotient can be calculated for fat metabolism plus carbohydrate metabolism.

Respiratory quotients.—The ratio of the volume of carbon dioxide expired to the volume of oxygen inspired during a given period of time is called the respiratory quotient. This ratio is based on the volumes of the two gases, not weights.

Under the law of Avogadro the number of molecules per cubic centimeter (or any unit of volume) is the same in all gases at the same temperature and pressure. Accordingly, a liter of oxygen contains the same number of molecules as a liter of carbon dioxide under standard conditions, but the molecular weight of oxygen is 32 and the molecular weight of carbon dioxide is 44, so a liter of the latter weighs more than a liter of oxygen. That is, the weights are as 32 to 44 or 8 to 11. Therefore, $\frac{\text{grams } CO_2}{\text{grams } O_2} \times \frac{8}{11} =$ respiratory quotient.

The respiratory quotient may be determined by measuring the quantity of oxygen consumed in a given period of time and by collecting and calculating the volume of carbon dioxide expired during the same time. The quotient may also be calculated by collecting a fair sample of expired air and determining the percentages of oxygen and carbon dioxide. This method was formerly taken into account in ventilation studies but the probable error is too great to make it practicable in metabolism studies. Gatewood considered average values to be as follows:

	O_2 per cent	CO_2 per cent
Inspired air contains	20.953	0.034
Expired air contains	16.033	4,380
Differences	—4.92	+4.346

$$\text{Respiratory quotient} = \frac{\text{Vol. } CO_2 \text{ excreted}}{\text{Vol. } O_2 \text{ consumed}} = \frac{4.346}{4.92} = 0.88$$

As remarked above, an individual's respiratory quotient in health varies considerably according to the state of metabolism at the moment.

Respiratory quotient for carbohydrate.—At all times proteins, fats, and carbohydrates are undergoing metabolism together but in varying proportionate amounts. However, if carbohydrate alone were being oxidized the respiratory quotient would be 1.0. That is because all carbohydrates contain hydrogen and oxygen in the proportions to form water. Comparatively little oxygen is required to effect complete combustion because of the relatively great amount of oxygen already present in the molecule. For example, the reaction in the case of glucose may be stated as follows:

$$C_6H_{12}O_6+6O_2=6CO_2+6H_2O$$

$$\frac{\text{6 molecules or 6 volumes } CO_2}{\text{6 molecules or 6 volumes } O_2}=1.0\text{, respiratory quotient.}$$

All carbohydrates are hydrolyzed in the body to glucose prior to oxidation.

Respiratory quotient for fat.—If fat alone were being metabolized the respiratory quotient would be about 0.707. That is the quotient ordinarily used in most calculations for mixtures of fat. The molecule of a fat contains more atoms of hydrogen than of oxygen. As a result of the comparative richness in hydrogen, or lack of oxygen in the molecule, relatively more oxygen is required from an outside source to effect complete combustion, and consequently weight for weight a fat furnishes more heat than a carbohydrate when completely oxidized.

Lusk states that edible fats are usually mixtures of various simple fats, consisting for the most part of tripalmitin, tristearin, and triolein, all of which require nearly the same quantity of oxygen for oxidation. The respiratory quotients for different edible fats are therefore practically the same. Experimental determinations indicate values of from 0.703 to 0.713.

Respiratory quotient for protein.—Individual proteins vary a great deal in their chemical composition. Any protein may be regarded as a compound of a number of amino acids, some of which are oxidized in the body to varying degrees under varying circumstances. For the purpose of the metabolism calculation the average quotient for mixed proteins is taken to be 0.801.

When carbohydrate is converted into fat in the body the change from a compound in which the molecule contains half as many atoms of oxygen as of hydrogen into a compound, the molecule of which contains a greater proportion of hydrogen, the consumption of oxygen from the inspired air is reduced to the extent that oxygen is

released in the transformation. The expired air may therefore contain a greater volume of carbon dioxide than the volume of oxygen absorbed from the inspired air for the oxidation of so much mixed carbohydrate, fat, and protein as is being oxidized at the time, and the respiratory quotient may rise above unity even though the combustion of no one of the three nutrients involves a quotient greater than 1.0.

The effect of muscular exercise upon the respiratory quotient must be borne in mind. The immediate effect of increased oxidation in the muscles is to increase the formation of carbon dioxide, and the increased volume appearing in the expired air may exceed the volume of oxygen absorbed for many minutes after violent exercise of a few seconds duration. Under such conditions the respiratory quotient may be considerably greater than 1.0. Hill, Long, and Lupton in England have shown that the respiratory quotient varies up and down in a striking manner during the onset of severe exercise and in recovery from it. At first it rises, attaining a value up to 2.0, while the respiratory center is still dealing with increased hydrogen ion concentration in the tissues. Hill observes that an amount of carbon dioxide equivalent to the amount of lactic acid still present as a result of the exercise must be driven off before the hydrogen ion concentration can return to its previous resting value. The resting value is reached several minutes after recovery of the muscles has commenced. Retention of carbon dioxide then occurs to prevent alkalinity greater than normal. From 20 to 50 minutes after cessation of hard muscular work the respiratory quotient is usually lower than 0.70 and may be but little higher than 0.60. After 40 minutes there is a gradual increase, but the respiratory quotient frequently does not return to 0.80 until 80 or 90 minutes have elapsed. Hill remarks that these large variations in the respiratory quotient during exercise and recovery therefrom show how necessary it is to exercise the greatest possible precautions if we wish to draw any conclusions from the respiratory quotient as to the substance being oxidized. Deductions are warranted only if the exercise is moderate and very long continued—the subject must be in a state of equilibrium. In careful experiments he has found the excess of oxygen used as a result of the exercise and the excess of the carbon dioxide given out to be precisely equal. When the subject exercises and observations are limited to short periods a number of observations are required and the volumes of oxygen and carbon dioxide must be averaged for consecutive periods covering both work and recovery phases.

After Hill's visit to this country DuBois made a series of calculations and found little difference between the quotients of basal

metabolism and those of the exercise increment, the average for the former being 0.835 and for the latter 0.782. He concluded that his patients during mild exercise consumed fat and carbohydrate in about the same proportions as when they were resting.

By assuming that the respiratory quotient for metabolized protein is 0.801 and by estimating the total quantity of nitrogen excreted in the urine, as stated above, the weights or volumes of carbon dioxide and of oxygen involved in the oxidation of proteins during an observation period may be separated from the calculations so that the respiratory quotient resulting only from the oxidation of carbohydrate plus fat during the period may be calculated, and from that figure by means of the table constructed by Zuntz and Schumburg and modified by Lusk, as follows, the amounts of fat and of carbohydrate metabolized may be separately calculated:

Significance of the nonprotein respiratory quotient—Analysis of the oxidation of fats and carbohydrates together in different proportions

[Table of Zuntz and Schumburg modified by Lusk]

R. Q.	Percentage of total oxygen consumed		Percentage of total heat produced		Calories per liter O_2	
	Carbohydrate	Fat	Carbohydrate	Fat	Number	Logarithm
	1	2	3	4	5	6
0.707	0	100.00	0	100.00	4.686	0.67080
0.710	1.02	99.00	1.10	98.90	4.690	.67114
0.720	4.44	95.60	4.76	95.20	4.702	.67228
0.730	7.85	92.20	8.40	91.60	4.714	.67342
0.740	11.30	88.70	12.00	88.00	4.727	.67456
0.750	14.70	85.30	15.60	84.40	4.739	.67569
0.760	18.10	81.90	19.20	80.80	4.751	.67682
0.770	21.50	78.50	22.80	77.20	4.764	.67794
0.780	24.90	75.10	26.30	73.70	4.776	.67906
0.790	28.30	71.70	29.90	70.10	4.788	.68018
0.800	31.70	68.30	33.40	66.60	4.801	.68129
0.810	35.20	64.80	36.90	63.10	4.813	.68241
0.820	38.60	61.40	40.30	59.70	4.825	.68352
0.830	42.00	58.00	43.80	56.20	4.838	.68463
0.840	45.40	54.60	47.20	52.80	4.850	.68573
0.850	48.80	51.20	50.70	49.30	4.862	.68683
0.860	52.20	47.80	54.10	45.90	4.875	.68793
0.870	55.60	44.40	57.50	42.50	4.887	.68903
0.880	59.00	41.00	60.80	39.20	4.899	.69012
0.890	62.50	37.50	64.20	35.80	4.911	.69121
0.900	65.90	34.10	67.50	32.50	4.924	.69230
0.910	69.30	30.70	70.80	29.20	4.936	.69339
0.920	72.70	27.30	74.10	25.90	4.948	.69447
0.930	76.10	23.90	77.40	22.60	4.961	.69555
0.940	79.50	20.50	80.70	19.30	4.973	.69663
0.950	82.90	17.10	84.00	16.00	4.985	.69770
0.960	86.30	13.70	87.20	12.80	4.998	.69877
0.970	89.80	10.20	90.40	9.58	5.010	.69984
0.980	93.20	6.83	93.60	6.37	5.022	.70091
0.990	96.60	3.41	96.80	3.18	5.035	.70197
1.000	100.00	0	100.00	0	5.047	.70303

Lusk gives the following example to illustrate the method of calculation by indirect calorimetry:

Subject: A dog weighing 12.75 kilograms. Period of observation: One hour

	CO_2 grams	O_2 grams	Respiratory quotient	Urine, N gram
Respiratory exchange	6.75	6.17	0.79	0.136
Deduct CO_2 derived from protein (0.136×9.35) =	1.27			
Deduct O_2 used in destruction of protein (0.136×8.45) =		1.15		
Nonprotein	5.48	5.02	.79	

	(3.51 liters O_2) Calories indirect	Calories direct
Protein calories (N×26.51) =	3.6	
Nonprotein calories (3.51 liters O_2×4.788, the heat value with R. Q. 0.79 from above table) =	16.8	
	20.4	20.92

From the Zuntz and Schumburg table it appears that with the nonprotein respiratory quotient, 0.79, 29.9 per cent of the heat produced by fat plus carbohydrate was derived from carbohydrate and 70.1 per cent from fat. That is, 5.02 calories from carbohydrate and 11.78 from fat. If 1 gram of carbohydrate yields 4 calories and 1 gram of fat 9 calories (these figures are approximately correct, but Rubner's factors would probably serve better in such a calculation), the dog metabolized during the hour 1.25 grams of carbohydrate and 1.3 grams of fat.

Taking the heat value of 1 gram of protein as 4 calories, $\frac{3.6}{4}=0.9$ gram of protein metabolized.

The same methods are used in calculating the metabolism of the human subject.

According to DuBois, the caloric value of pure protein burned in a bomb calorimeter is much higher than the figures used to represent its fuel value to the body. Fat free beef yields 5.3 to 5.7 calories per gram; casein, 5.6 to 5.8; and egg white, 5.7 calories. Rubner's factor, 4.1 calories is taken to represent more nearly the average value of the proteins of food.

In setting the value at 4.1 Rubner allowed for usual losses of nitrogen in the feces, the protein from which such nitrogen is derived not having yielded heat in the body. Atwater assumed that 1 gram of meat protein yields 4.25 calories to the body and 1 gram of vegetable protein, 3.87 calories. DuBois writes that more recent

work indicates that the average yield in the body from vegetable proteins is 3.98 calories per gram.

Rubner's factor for carbohydrate is 4.1 calories per gram and for fat, 9.3 calories per gram. It may be assumed that fats and carbohydrates are ordinarily absorbed entirely from the intestines and that no deduction need be made for loss in the feces. That is not the case under certain conditions, to be sure.

Bomb calorimeter.—The bomb calorimeter is a steel cylinder used for determining directly the heat of combustion when foods or fuels are burned in oxygen. The food is powdered and a carefully weighed portion is placed in the bomb, which is then filled with oxygen to a pressure of 25 pounds or more. A linen thread drops into the powdered food and is attached to a piece of platinum wire just above, through which an electric current is passed to heat it to incandescence. The bomb is placed in a vacuum container which holds a measured quantity of distilled water. When the current is turned on, the linen thread and food are ignited and burn completely. A few minutes later when the heat generated has diffused so that the temperature of the metal and temperature of the water are equal, the fuel value is calculated from the following data:

1. Increase in the temperature of the known volume of water.
2. Water thermal equivalent of the heat remaining in the metal of the bomb.
3. Heat of combustion of the linen thread.
4. Heat generated by the electric current in the platinum wire.

METABOLISM IN HEALTH

In metabolism work the standard for comparison is the quantity of heat produced by the subject (large calories) per square meter of body surface per hour or per day, under *basal conditions*. Ordinarily it is the production of heat and not loss of heat to the environment that is of interest. Heat loss is variable, depending not only upon the rate of heat production but upon the temperature and other conditions in the environment. Heat production in a state of repose is relatively constant.

The term *basal metabolism* has been in common use for about 10 years. It means the rate of heat production by an individual wide-awake but at rest, 14 to 18 hours after food is ingested, to avoid the effect of specific dynamic action of nutrients. The environmental conditions must be such as will involve neither the stimulation of cold that will result in the increased production of heat nor the effect of external heat that will raise the temperature of the body.

Under such conditions the production of heat is remarkably constant. Lusk states that the basal metabolism of his friend Dr. E.

F. DuBois during a period of 11 years varied not more than plus or minus 8 per cent from the average and the average variation was $\pm$ 3.4 per cent.

Of course, the total amount of heat produced by a man in 24 hours depends upon his size, his activities, the nature and quantity of food eaten, and sometimes indirectly upon atmospheric conditions. Heat production per pound of body weight is not constant. Small animals produce more heat per unit of weight than large animals. But, as Rubner demonstrated many years ago, the basal metabolism of man and warm-blooded animals per unit area of body surface is quite constant. The heat production per square meter of body surface is about the same, not only for different individuals but for lower animals of different species. Lusk stated (Mayo Foundation Lecture), "I would have you bear always in mind the constancy of the basal metabolism and its general conformity to the law of surface area." This point was stressed because some students of metabolism have denied the validity of this conclusion.

Rubner's figure for man was 1,042 calories per square meter of surface in 24 hours (43.4 per hour). He found that the value for an adult man in starvation was 1,134 calories (47.2 per hour); for a man on mixed diet, 1,189 (49.5 calories per hour); for a dwarf, 1,231 (51.3 per hour); and for a breast-fed infant, 1,221 calories per square meter in 24 hours, or 50.8 calories per hour.

Of course, surface area does not govern the production of heat. That is a function of the mass of body tissues and tissue activity, but it is true nevertheless that a fairly constant relationship exists between the quantity of heat produced and the surface area of the body. Why that is so need not be conjectured here, but since the relationship has been found to hold it offers a convenient means of comparing the heat production of different individuals under similar (basal) conditions.

Estimation of the surface area of the body.—Benedict writes, "This standard of reference is extremely simple and very practical and the medical profession and physiologists as a whole owe a great debt to Dr. Eugene F. DuBois for it." DuBois's height-weight formula for calculating the surface area of the human body is now in general use in metabolism work. The formula is:

$$A = W^{0.425} \times H^{0.725} \times C$$

or more conveniently for solving:

$$\text{Log } A = (\text{Log } W \times 0.425) + (\text{Log } H \times 0.725) + 1.8564$$

A = surface area in square centimeters.

H = height in centimeters.

W = weight in kilograms.

C = a constant; 71.84. Log 71.84 = 1.8564.

Sherman, in his "Chemistry of Food and Nutrition," presents the following table which gives the surface area in square meters for different heights and weights according to the above formula of E. F. DuBois and D. DuBois.

Height in centimeters	Weight in kilograms																
	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
200	-----	-----	-----	-----	-----	-----	1.84	1.91	1.97	2.03	2.09	2.15	2.21	2.26	2.31	2.36	2.41
195	-----	-----	-----	-----	-----	1.73	1.80	1.87	1.93	1.99	2.05	2.11	2.17	2.22	2.27	2.32	2.37
190	-----	-----	-----	1.56	1.63	1.70	1.77	1.84	1.90	1.96	2.02	2.08	2.13	2.18	2.23	2.28	2.33
185	-----	-----	-----	1.53	1.60	1.67	1.74	1.80	1.86	1.92	1.98	2.04	2.09	2.14	2.19	2.24	2.29
180	-----	-----	-----	1.49	1.57	1.64	1.71	1.77	1.83	1.89	1.95	2.00	2.05	2.10	2.15	2.20	2.25
175	1.19	1.28	1.36	1.46	1.53	1.60	1.67	1.73	1.79	1.85	1.91	1.96	2.01	2.06	2.11	2.16	2.21
170	1.17	1.26	1.34	1.43	1.50	1.57	1.63	1.69	1.75	1.81	1.86	1.91	1.96	2.01	2.06	2.11	-----
165	1.14	1.23	1.31	1.40	1.47	1.54	1.60	1.66	1.72	1.78	1.83	1.88	1.93	1.98	2.03	2.07	-----
160	1.12	1.21	1.29	1.37	1.44	1.50	1.56	1.62	1.68	1.73	1.78	1.83	1.88	1.93	1.98	-----	-----
155	1.09	1.18	1.26	1.33	1.40	1.46	1.52	1.58	1.64	1.69	1.74	1.79	1.84	1.89	-----	-----	-----
150	1.06	1.15	1.23	1.30	1.36	1.42	1.48	1.54	1.60	1.65	1.70	1.75	1.80	-----	-----	-----	-----
145	1.03	1.12	1.20	1.27	1.33	1.39	1.45	1.51	1.56	1.61	1.66	1.71	-----	-----	-----	-----	-----
140	1.00	1.09	1.17	1.24	1.30	1.36	1.42	1.47	1.52	1.57	-----	-----	-----	-----	-----	-----	-----
135	0.97	1.06	1.14	1.20	1.26	1.32	1.38	1.43	1.48	-----	-----	-----	-----	-----	-----	-----	-----
130	0.95	1.04	1.11	1.17	1.23	1.29	1.35	1.40	-----	-----	-----	-----	-----	-----	-----	-----	-----
125	0.93	1.01	1.08	1.14	1.20	1.26	1.31	1.36	-----	-----	-----	-----	-----	-----	-----	-----	-----
120	0.91	0.98	1.04	1.10	1.16	1.22	1.27	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

DuBois, in applying the formula to the cases of a large number of men studied by Benedict as well as to those studied by himself, found that for all men studied who were under 50 years of age the basal metabolism was within 15 per cent of the average, 39.7 calories per hour per square meter of surface area thus computed, and that in 86 per cent of the cases basal metabolism was within 10 per cent of the average.

In the clinical basal metabolism laboratory the following values offered by DuBois and Aub are usually taken to represent average normal metabolism for males and females at different ages.

Calories per square meter of body surface per hour

Age	Male	Female	Age	Male	Female
14–16 years	46.0	43.0	40–50 years	38.5	36.0
16–18 years	43.0	41.0	50–60 years	37.5	35.0
18–20 years	41.0	38.0	60–70 years	36.5	34.0
20–30 years	39.5	37.0	70–80 years	35.5	33.0
30–40 years	39.5	36.5			

In general the rate of basal metabolism is higher for children than for adults. Studies of the metabolism of the newborn have shown that the rate of heat production is lower per unit of surface area than is the case with adults, but the heat production per kilogram is higher. Heat production per square meter of body surface increases during the first few months of life and by the end of the first year the rate is a little higher than for adults. At 5 years the

rate is about 60 calories per square meter per hour. After that the rate gradually falls; at 10 years it is about 50 and at 15 years about 45 calories per square meter.

METABOLISM IN STATES OF UNDERNUTRITION

Undernutrition may result from disease, activity of ductless glands, or from the ingestion of less food than is required to keep the subject well nourished.

The tissue changes that take place in starvation have been briefly discussed. Benedict's experiment with a fasting subject indicated that the rate of basal metabolism on the first day of the fast was about 38 calories per square meter of body surface per hour; on the twenty-first day, about 28 calories; and on the thirty-first day, about 31 calories. During the 31 days the subject lost 16.7 per cent of his body weight. DuBois considers that the decreased rate of basal metabolism was not due merely to decreasing body weight but also to some not understood compensatory mechanism which tends to protect the organism deprived of food.

Prolonged deficiency of food.—In general persons whose diets have been for a long time too low in fuel value for their needs have been found to have rates of basal metabolism from 20 to 33 per cent less than 40 calories per square meter of body surface per hour. An inadequate diet results in loss of body weight, including loss of body proteins and usually in a lessened inclination to make muscular exertion. Undernourished individuals, as a rule, are sensitive to cold and feel chilly when atmospheric conditions are comfortable for other persons similarly clothed.

The above remarks apply to persons free from chronic infection, digestive disturbances, functional disorders, diabetes, diseases of the thyroid glands, etc. They apply to healthy subjects, who for experimental purposes or for other reasons have been deprived or have deprived themselves of sufficient nutrient material to prevent loss of body weight.

Undernutrition often involves deficiencies in one or several essential dietary factors—vitamins, minerals, etc.—and the effects may thus be complicated, as Mann found among native prisoners in Haiti, many of whom had subsisted for prolonged periods on near starvation diets before entering jail. Patients who have been unable to assimilate a maintenance diet because of chronic gastrointestinal disease, disease of the gall bladder, etc., may also suffer the consequences of deficiency of calcium or vitamin deficiencies in addition to the general results of ingesting too little fuel. Diabetes of course involves special consequences resulting from inability to oxidize carbohydrates.

Some persons who are thin in spite of liberal feeding have been found to show a greater than average specific heat production from proteins or carbohydrates, or both. This may be due to unusually active secretion of insulin and other ferments, so that food, even when greatly in excess of current requirements, is burned instead of being stored as in the case of so-called well-nourished individuals.

Metabolism in diseases of the thyroid gland.—Even in very mild cases of exophthalmic goiter the rate of basal metabolism is usually increased from 15 to 30 per cent; in mild cases from 30 to 50 per cent; and in severe cases from 50 to 75 per cent and sometimes more than 75 per cent.

A reduced rate of basal metabolism is likewise quite characteristic of hypothyroidism. In cases where myxedematous changes have occurred the rate is reduced 15 to 40 per cent.

Metabolism in infectious diseases accompanied by fever.—While the temperature is elevated the rate of metabolism is increased. The respiratory quotient is usually within normal limits. Although there is increased destruction of body protein there is also increased oxidation of fat and carbohydrate. In acute diseases the rate of metabolism is reduced greatly as soon as active infection ceases. During the first week of convalescence after prolonged acute infectious disease the rate may be very low, gradually rising thereafter until the normal level is reached two or three weeks later. During convalescence, while nitrogen is being stored and fat deposited, the respiratory quotient is high, 0.9 to 1.0, and during this stage of the recovery period the quotient may be higher than unity 14 hours after taking food into the stomach.

Increase in the rate of metabolism is primarily due to the chemical action of bacterial toxin in stimulating destruction of protein and oxidation of fat and carbohydrate; secondarily, to the effect of increased temperature of the tissues, which also increases the rate of metabolism regardless of whether the cause of temperature elevation is toxic action, overfeeding, overexertion, or exposure to environmental heat as in hot firerooms.

There is a tendency for the rate of metabolism to be lower in pulmonary tuberculosis during febrile periods than with corresponding degrees of temperature in other infectious diseases. DuBois believes that is due to the fact that the disease is often accompanied by high fever with comparatively slight toxemia and little or no toxic destruction of protein. He states that other fevers give rather uniform results and the average rise in heat production may be said to be about 13 per cent for each degree centigrade (7.2 per cent for each degree Fahrenheit). The total metabolism of a fever patient may be calculated by adding to what should be his normal

basal metabolism the reckoned increase for his degree of fever with an added allowance of 10 per cent for very toxic patients or those taking much food, and in the case of restless patients an allowance of from 10 to 30 per cent for muscular activity.

In many cases of pulmonary tuberculosis metabolism is increased, even though not in the same ratio to elevation of temperature as in other infectious diseases. In active but nonfebrile cases the rate is often increased 20 to 35 per cent, and increases of from 50 to 75 per cent have been noted in the presence of fever. In tuberculosis cases the specific dynamic action of food ingested may be an important factor making for increased heat production.

METABOLISM IN DIABETES

Rate of basal metabolism.—A diabetic patient, like other persons, is under basal conditions for only a small part of the day and his diet, of course, should be adjusted if possible to the needs of a moderately active person. In studying the needs of diabetics with a view to planning diets it would be preferable to have metabolism data compiled from long-period observations of diabetic subjects in the calorimeter respiration chamber, but such data appear to be lacking. However, to the student of metabolism in general, basal metabolism determinations for diabetics are of some interest. While the metabolism of the subject who lacks full power to oxidize carbohydrate can not be compared with the metabolism of healthy subjects or with basal metabolism determinations in other diseases, much useful knowledge of normal metabolism has come from studies of diabetic subjects and phlorhizinized or depancreatized dogs. So far as basal metabolism is concerned, there is the special difficulty that with emaciation the surface area of the individual changes less than his weight.

DuBois summarizes the information available about as follows: In mild cases of diabetes basal metabolism is normal. In severe cases the basal rate may be somewhat increased, but inasmuch as such patients are usually undernourished the B. M. R. is usually lower than for healthy persons. The percentage decrease in the hourly rate per square meter is usually proportional to the degree of emaciation, and in extreme cases may be 30 to 40 per cent below the average. In most cases, by the rational use of insulin, the weight of the patient may be increased, and with better nourishment the B. M. R. may be expected to increase. In the smaller number of severe cases in which an increase instead of a decrease in the rate of basal metabolism is noted, destruction of protein is considered largely or entirely responsible for the increase. In one such case, Gebhart, Aub, DuBois, and Lusk calculated that high protein metab-

olism caused sufficient specific dynamic action to account for 17 to 19 extra calories per hour. DuBois considers that while severe acidosis may possibly cause a moderate increase in the B. M. R., it is also possible that an increase correlated with acidosis may be due not to the acidosis but to the factors causing acidosis.

Allen and DuBois as a result of studies made several years ago concluded that the level of basal metabolism in diabetes is the resultant of a number of forces which include processes tending to increase heat production, such as increased destruction of protein, and conditions tending to decrease the production of heat, such as undernutrition and lack of muscular exertion. Acidosis may be a factor.

The respiratory quotient in diabetes.—As a rule the respiratory quotient is low because the diabetic is oxidizing proportionately less carbohydrate than the healthy subject. The level of the quotient is generally used as an index of the severity of the disease. However, in so using it one should make sure that carbohydrate is being fed up to the limit of tolerance, and also bear in mind the total heat production in relation to the estimated needs of the patient. For example, a small and emaciated patient may have a comparatively high quotient, although very little carbohydrate is being oxidized, if these is reduced metabolism of protein and fat at the time, so that the total heat production is very low.

In diabetes the power to oxidize protein is reduced because by weight about half of the protein metabolized is convertible into carbyhydrate. Lusk, by studying the urine of phlorhizinized dogs sufficiently long after the elimination of previously ingested carbohydrate had ceased, so that it could be taken for granted that all sugar appearing in the urine was derived from protein, determined the ratio of dextrose to nitrogen to be 3.65 to 1. This ratio indicated that 58 per cent of the protein was converted into carbohydrate, and it is now generally assumed in the case of the human subject that the carbohydrate derived from protein represents 58 per cent of the weight of the protein ingested or metabolized. A D. to N. ratio in the urine of 3.65:1 is to be found, of course, only when the power to oxidize carbohydrate is completely lost. Most diabetics can oxidize considerable sugar and it is probable that the so-called complete diabetic can oxodize a little. In planning diets for diabetic patients it is a common practice to calculate the total available carbohydrate by adding to the food carbohydrate as weighed, 58 per cent of the ingested protein, or in some cases 58 per cent of the protein metabolized as calculated from total nitrogen excreted in the urine.

According to DuBois, the respiratory quotient for protein with complete loss of power to oxidize carbohydrate would be 0.632, but

inasmuch as protein scarcely furnishes more than 20 to 30 per cent of total calories, the respiratory quotient, even in complete diabetes, will be found above 0.632 and will actually more nearly approach that of fat, 0.707. But in complete diabetes with ketone bodies being excreted as the result of incomplete combustion of fat, the quotient for fat is also reduced—to about 0.669 instead of 0.707. The quotient for fat is also affected by the extent to which keto acids are neutralized by bases—bicarbonates. Glycerol constitutes about 10 per cent of fat by weight, and allowance must be made for its oxidation and possible conversion into glucose. Conversion in part would lower the respiratory quotient a little. Everything considered, it is understandable that a complete diabetic might have a respiratory quotient as low as 0.667.

High quotients occasionally determined for diabetics are understandable in view of the fact that the patient may store a considerable quantity of carbohydrate as shown by Joslin, Ladd, and others.

The specific dynamic action of the food ingested must be taken into consideration, but even in severe cases of diabetes the effects seem to be about the same as in healthy subjects when allowance is made for the limited amount of carbohydrate that can be oxidized. The amount burned depends, of course, largely upon the amount of insulin the pancreas is able to make available. The ingestion of an excess of carbohydrate does not increase heat production as in health, and the respiratory quotient is not raised because the excess amount can not be burned. However, in the unusual case there may be a rise in the quotient resulting from conversion of carbohydrate into fat. The kind of carbohydrate may make some difference. Joslin's studies seem to indicate that levulose may be burned by some diabetic patients who are unable to oxidize an equal amount of glucose. The respiratory quotient is proportionately raised to the extent that levulose is oxidized.

Ketosis with Special Reference to Diabetes and Acidosis in General

The present theoretical accounting for ketosis in diabetes is based on the calculations made by Shaffer and Woodyatt. After performing experiments in vitro and studying the effects of different proportions of fats and carbohydrates in the food of diabetics and other subjects they decided that *a fat molecule is completely oxidized only if a molecule of glucose is oxidized at the same time.*

Taking the molecular weight of glucose as 180 and considering the average molecular weight of fatty acids as 270, it is necessary, if there are to be equal numbers of molecules, that there be 1 gram of carbohydrate for 1.5 grams of fatty acids. This relationship represents what is termed the *ketogenic-antiketogenic ratio.*

To determine what the ratio is for the food as ingested, or to plan a diet that will conform to the 1:1.5 ratio, the following allowances are made:

(*a*) Fatty acids are considered to represent about 90 per cent of fat by weight. Fatty acids are ketogenic.

(*b*) Glycerol is considered to constitute 10 per cent of the fat by weight. Glycerol is reckoned as antiketogenic.

(*c*) Amino acids that may form aceto-acetic acid are considered to constitute 44 per cent of the weight of mixed food proteins; consequently that percentage of the protein is placed on the ketogenic side of the equation.

(*d*) About 58 per cent of the protein is regarded as convertible into carbohydrate and is, therefore, placed on the antiketogenic side of the equation.

(*e*) Carbohydrate is considered to be wholly resolvable into glucose which is antiketogenic.

The ratio would, therefore, be:

$$\frac{\text{Ketogenic material}}{\text{Antiketogenic material}} = \frac{\text{44 per cent of the protein plus 90 per cent of the fat}}{\text{Carbohydrate, plus 58 per cent of the protein, plus 10 per cent of the fat}}$$

For clinical purposes, roughly, 50 per cent of the protein is considered to serve as antiketogenic material, and it is also considered that a mixture in which grams of fat are equal to twice as many grams of carbohydrate plus one-half the grams of protein to be ingested represents a diet containing the largest proportion of fat that can be oxidized without increasing the excretion of ketones.

It is probable that diabetics as well as normal subjects differ somewhat with respect to ability completely to oxidize fat in the presence of given proportions of glucose, so that a narrower ratio might be required for some patients than others to avoid the excretion of aceto-acetic acid and the formation of betahydroxybutyric acid and acetone. Shaffer concluded in 1922 that *one molecule of glucose is sufficient for the complete oxidation of two molecules of aceto-acetic acid when there is an excess of ketones.* DuBois states that we are in doubt as to the exact molecular ratios, and that all that can be said is that with an excess of keto acids in the body, one oxidizing molecule of glucose can aid in the complete combustion of about two molecules of fatty acid, and that when there is little or no acidosis there seem to be required to prevent accumulation of ketones two molecules of glucose for two molecules of fatty acid (1:1 ratio). Therefore, in planning the diet, the food ratio as given above must be followed—1:1.5 (weight of carbohydrate to weight of fatty acid)—

even though the patient can get along without disastrous consequences, in case of necessity, with about half the amount of carbohydrate required to give this ratio.

The administration of insulin is a logical method of combating acidosis in diabetes because the acidosis is primarily a matter of ketosis and the oxidation of an increased amount of glucose is the certain means of preventing further accumulation of ketones and aiding in the oxidation of ketones already accumulated in the system. But there is still evidence to support the practice of strengthening the alkali reserve of the body by administering basic ions.

Although deficiency of insulin is primarily the cause of incomplete oxidation of fatty acids in diabetes, under any and all conditions involving acidosis, when there is interference with the burning of fat, whether due to an insufficient number of oxidizing glucose molecules or to failure of oxygen to reach the tissue cells in sufficient volume, there is necessarily a departure from the physiological process of complete oxidation of aceto-acetic acid to the end products, carbon dioxide and water. DuBois mentions the fact that 100 grams of fat ingested releases in its combustion in the body more than 100 grams of water. That gives a good idea of the relatively great amount of oxygen required to satisfy completely the affinity of the hydrogen rich fat molecule.

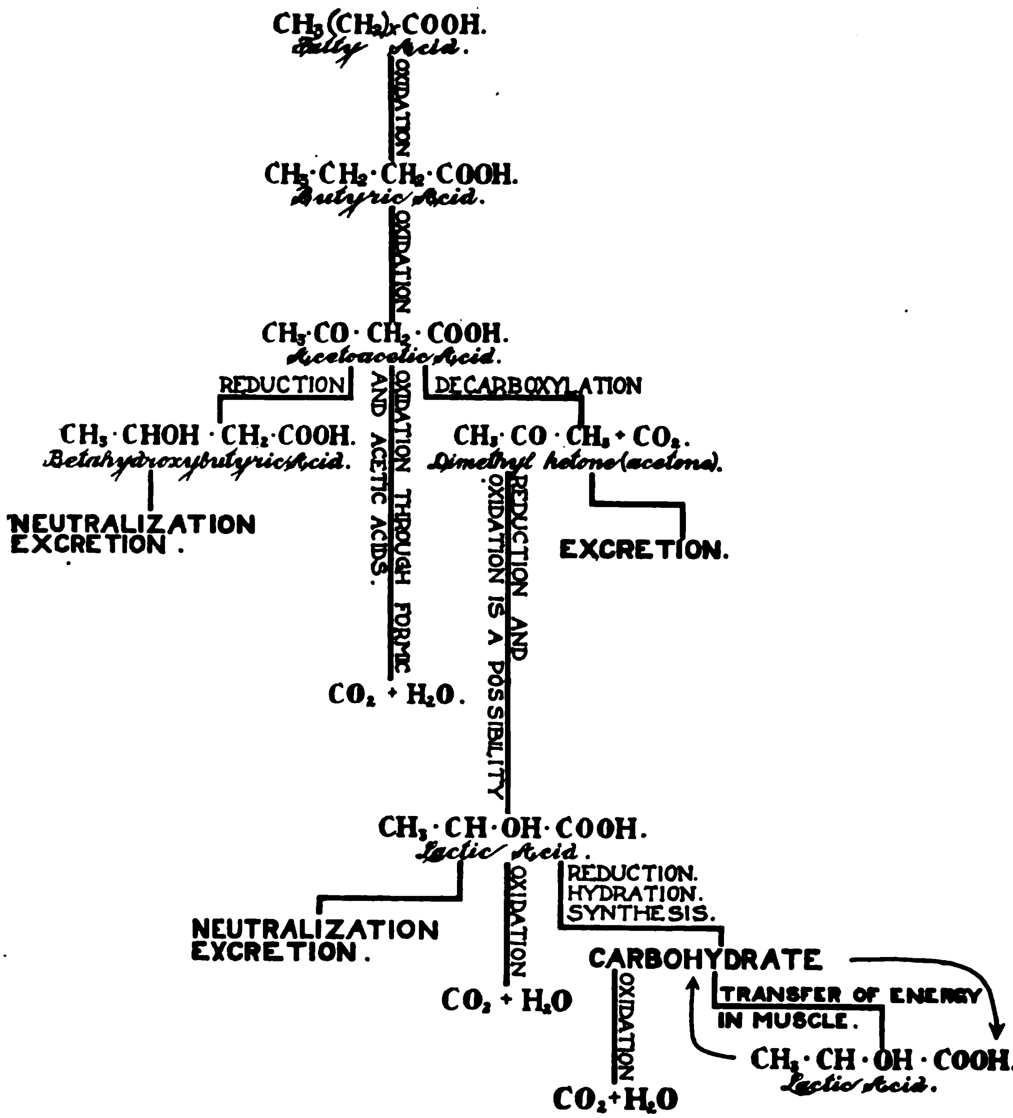
It was formerly thought that aceto-acetic acid was derived from betahydroxybutyric acid by oxidation. The theory was in keeping with the idea that catabolic changes were oxidative in character throughout. Hawk states that the introduction of betahydroxybutyric acid into the body is not followed by increased aceto-acetic acid formation, whereas betahydroxybutyric acid is formed when aceto-acetic acid is introduced. According to Hawk, betahydroxybutyric acid is found in normal urine in traces, but in larger quantities it is found only in conjunction with either acetone or aceto-acetic acid or both, although either or both may be found in acidosis cases in considerable amounts without betahydroxybutyric acid. Acidosis is usually severe when the latter is found in the urine.

Chemical reactions of different types resulting in the formation of many intermediary products are possible with the aid of ferments in the body, so that failure to produce a compound in the chemical laboratory even with drastic treatment does not necessarily prove that the same can not be produced in the animal body where hydrolysis, reduction, and synthesis, as well as oxidation, occur under many different conditions.

So far as known, the chemical changes incidental to the utilization of fat as a fuel in health are as follows: The fat is split into glycerol and fatty acid. The latter is oxidized through unknown interme-

diary products to butyric acid which is oxidized in turn to aceto-acetic acid on through formic and acetic acids to the end products, carbon dioxide and water. This course is indicated in the accompanying diagram by the line of changes down through the center.

According to Hawk, when there is interference with complete combustion, aceto-acetic acid is in part reduced to betahydroxybutyric acid and in part changed by the splitting off of carbon dioxide



into acetone which is dimethyl ketone. The resulting ketosis, a form of acidosis, may be of all degrees. Acetone has no affinity for base and neither accumulation nor excretion involves withdrawal of basic ions from the tissues, but both aceto-acetic (diacetic) acid and betahydroxybutyric acid are neutralizable, so that, when accumulating as a result of constant production, considerable depletion of the

alkali reserve of the organism can occur in the course of time unless the diet is such that the loss of basic ions is replaced.

When it is considered that American dietaries in general tend to be deficient in calcium and in foods that yield basic ash generally in comparison with foods that give acid-forming ash, it appears highly probable that the diabetic subject is not ingesting enough calcium to meet the requirement unless special thought has been given to providing that element in sufficient quantity. Doubtless the administration of sodium bicarbonate to diabetic patients has often been overdone, and possibly it has been harmful, especially when coma threatened. Nevertheless, when the tolerance for carbohydrate is so low that the patient can not be maintained without excreting diacetic acid on a reasonably high plane of nutrition with fat and so much carbohydrate as it is considered advisable for him to oxidize with the aid of injected insulin, it would appear rational to strengthen his alkali reserve be feeding moderate amounts of calcium oxide, disodium phosphate, and bicarbonate of sodium from day to day. And the judicious use of a similar mixture of basic ions would seem to be advisable in case coma develops even though the primary indication is to get carbohydrate plus insulin into the system. One gram of calcium may be regarded as the daily requirement in health, and four or five times that amount is ingested by some healthy persons. Four grams represents a moderate amount of sodium bicarbonate and of basic sodium phosphate. There is little or no evidence that harmful alkalosis can occur. Alkalies are readily eliminated by the kidneys. The kidney nicely controls the hydrogen ion concentration of the blood so far as preventing concentration of basic ions is concerned. Any excess of alkali results immediately in reduction of the amount of ammonia formed for the neutralization of acids, the amount of nitrogen that would otherwise be excreted as ammonia leaving the body as urea. The danger is altogether on the side of acidosis, not alkalosis, in view of the constant formation of mineral acid ions (H_2SO_4) and phosphoric acid in health as well as in disease, and the ease with which the kidney eliminates alkali.

While the foregoing remarks seem germane to the subject, the purpose of this article is not to discuss the treatment of diabetes but rather to consider the essential features of acidosis as it occurs with somewhat different manifestations depending upon various etiological factors.

Sellards (Principles of Acidosis and Clinical Methods for Its Study) summarizes the mechanism of the normal equilibrium between acids and bases existing in health, as follows: A slightly alkaline reaction of the blood is constantly maintained, primarily by the following means:

1. Intake of fixed bases in the food.
2. Elimination:
   (*a*) of carbon dioxide by the lungs.
   (*b*) of acid by the kidney.
3. Neutralization of acid in the body by ammonia.

Organic acid radicles are burned to carbon dioxide and water but mineral acid is also formed in the destruction of protein. This can not be oxidized and must be neutralized and excreted or retained.

There is a lessening of the alkali reserve in the case of keto-acidosis, even as it occurs in diabetes, where it is due to failure to oxidize available carbohydrate and not to other causes of incomplete oxidation of fat which may be associated with acidosis arising from other causes, infection, starvation, exhaustion, etc. According to Sellards, definite acidosis may develop in diabetes without the appearance of aceto-acetic acid in the urine, and acidosis may exist even when the output of acetone and ammonia is within normal limits. He continues, " Evidently, considerable precaution is necessary in drawing conclusions regarding acidosis from the examination of the urine for acetone in diabetes, since the presence of acetone does not establish the existence of acidosis, and its absence by no means proves the absence of acidosis. A similar relationship pertains between the acetone bodies and acidosis in children."

With regard to betahydroxybutyric acid; inasmuch as the fixed bases do become depleted in diabetes, it may well be that, although the patient ceases to excrete this acid as a result of oxidizing an increased amount of carbohydrate, the acidosis continues, and it probably will continue for some time unless basic ions are taken in to restore the reserve in greater amount than ordinarily furnished in the diet.

The fuel that is burned to support energy and maintain body temperature is probably oxidized for the most part in the muscles. Therefore the subject of acidosis is linked with the question of how work and heat are produced by the muscles. The old idea was that energy was released directly by the oxidation of carbohydrate and fat, but it seems more reasonable to conclude that the energy used in contracting a muscle is potential, stored by the oxidation of carbohydrate or fat in the rest intervals or periods of recovery between contractions.

A. V. Hill, of London, England, dealt with this assumption and gave an interesting account of recent experimental work performed by himself and colleagues, as well as by other investigators, in the lecture delivered by him in this country during the course of Mayo Foundation Lectures, 1924–25.

The work of Krogh and Lindhard suggests that carbohydrate when available, and there is always some available, is the fuel primarily burned in the production of muscular work. Hill believes that fat may be so used only after "conversion" (into carbohydrate?) involving a 10 per cent loss of energy. He infers that fat is used only in a secondary manner, for example, to restore the carbohydrate which has disappeared. He considers that the whole oxidative cycle of the recovery of muscle after the release of energy for the production of work is carried out at the expense of carbohydrate in all cases, and that the essential element in the machinery is *lactic acid*, itself derived from carbohydrate.

Hill refers to the work of Fletcher, Hopkins, Myerhof, and Emden, and discusses the possibility that phosphorus may play an indispensable part in the formation of the lactic acid. Glycogen appears to bear a quantitative relationship to lactic acid production. Emden believes that the origin of the lactic acid formed in the muscle is a hexose diphosphoric ester. Lactic acid can be formed by fermenting various carbohydrates, and in muscles it is considered that glycogen is the source. Hill states that the total amount of glycogen present in a muscle is adequate to account for the whole of the energy used in the most prolonged series of contractions that an isolated muscle is capable of carrying out in oxygen. Fat is not oxidized in the isolated muscle. Therefore it may be surmised that the action of ferments or other catalytic agents or the cooperation of other organs is required for the energy content of fat to be utilized.

Hill mentions that a ferment, glyoxalose, capable of transforming methyl glyoxyl, $CH_3.CO.CHO$, into lactic acid, has been found in all tissues of the body except the pancreas, both in diabetic and healthy persons, and that the pancreas contains an antisubstance that inhibits the action of this ferment. Insulin has no such effect but there is apparently a substance in the pancreas which has a controlling action on the carbohydrate breakdown of muscle.

The crux of the matter is, according to Hill, that lactic acid is necessarily formed as a step in the performance of muscular work, the mechanism for the release of energy being analogous to that of a storage battery. When a muscle is stimulated there is initially work and a large production of heat, which is attributed to the formation of lactic acid from glycogen and its subsequent neutralization. After that a recovery period follows during which oxidation goes on with consequent liberation of heat for many minutes, the muscle finally being restored completely to its initial condition. He considers that the initial discharge of energy, which may take place at a high rate, in no way depends upon the oxygen supply, but the recovery depends directly upon the oxidation of fuel.

The lactic acid formed in the contraction period is in part neutralized and in part buffered by protein salts, the latter condition especially involving the liberation of a large amount of heat. It seems clear that the lactic acid is not oxidized in the work phase. It is removed in the recovery period, during which apparently only about one of every five molecules is oxidized, the other four being restored "to the place or as the substance from which they came." He regards lactic acid in muscle as being a part of the machinery rather than fuel.

The experiments carried out by Hill, Long, and Lupton indicate that the lactic acid formed in the muscle during contractions has a preponderating effect upon the respiratory quotient. As lactic acid is liberated the hydrogen ion concentration of the tissues is increased and an amount of CO_2 must be eliminated equivalent to the lactic acid still present. The respiratory quotient rises sharply. As lactic acid is removed, carbon dioxide is retained by the body. The excess of oxygen used as the result of any given amount of muscular work and the excess of carbon dioxide excreted are precisely the same. The oxygen requirement for a given amount of work is of course always the measure of the total amount of energy required from fuel for that work.

Mill's words suggest that lactic acid is the analogue of sulphuric acid serving as the electrolyte in a lead storage battery. This is all highly theoretical. It may be so, and it may be that lactic acid is only one of the indispensable elements. Glutathione has been shown to have its importance as an agency through which the tissues receive or are enabled to absorb oxygen. This cystine compound may also play an important part in the release of stored potential energy.

Hill plainly considers that the utilization of fat as fuel can occur in the muscles only after its previous "conversion" somewhere in the body—probably not in muscle. He does not express an opinion as to the nature of the compound into which the fat is converted. It is clear enough that experimental animals, Eskimos, diabetic subjects, and healthy persons generally, can perform hard work very largely at the expense of fat as the fuel.

It is possible that the precursor of lactic acid is the immediate source of dynamic energy and that the potential is restored during the recovery period by the removal of the acid which in part is reconverted to its precursor. If such be the case, and if lactic acid must be formed in order that energy be released, the question arises, How can lactic acid be derived from fat other than by preliminary conversion into carbohydrates of some form? There is no good evidence that fats are converted into carbohydrate in the body. DuBois in

his Mayo Foundation Lecture touched upon this point. He said, "It is quite easy for the chemist to see how glycerol would be changed into glucose, and there is much evidence to prove that this actually occurs, but glycerol forms such a small part of the fat molecule and the respiratory quotient is so little affected that the process can not be detected in the quotient. The chemist can also write reactions showing the theoretic transformation of fatty acid into glucose, and most investigators in Europe believe that this actually occurs. Personally, I am quite convinced by the arguments of Lusk and other American biochemists that this has never been proved. If it did occur, all the modern theories of antiketogenesis would fall by the board. * * * The complete diabetic excretes no sugar that does not come from carbohydrates or the carbohydrate portion of the protein molecule or from glycerole. * * * It is quite possible that fat passes through some carbohydrate-like stage as it is oxidized. All we can say is that it passes through this stage so quickly that it makes no difference to the practical results."

It is theoretically possible that lactic acid is derived from fatty acid in the course of the breaking-down changes taking place in the body, which are for the most part oxidative in character but not exclusively so. It is understandable that the concomitant oxidation of a molecule of glucose for each molecule of fatty acid is generally required to prevent excess formation of keto acid. In the diagram presented on a preceding page to represent the formation of aceto-acetic acid from fatty acids and subsequent steps in oxidation to the end products, carbon dioxide and water, a possible way in which lactic acid could be derived from acetone in health as well as in diabetes is also indicated. While such derivation has not been established by experimental studies it is quite possible that lactic acid does come from fatty acid in this or some other manner. At any rate it would seem necessary to make the general assumption that lactic acid is formed from fatty acid in the body in order to reconcile Hill's conclusions regarding the experiments performed by Long, Lupton, and himself, with the generally accepted explanation of the formation of ketones and the theory of acidosis in general. If this assumption is made it is understandable that the lactic acid thus formed could be largely restored in the course of the work-recovery cycle of a muscle to a carbohydrate-like precursor, which might even be glycogen, without being measurable from the respiratory quotient or giving any evidence of its formation that could be detected by subtracting total carbohydrate excreted from total carbohydrate, glycerol, and 58 per cent of protein ingested.

With regard to acidosis in general it may be assumed that the burning of fuel in muscles is largely responsible for the increase in

hydrogen ion concentration that occurs. In some types of acidosis, particularly the diabetic, but also in acidosis occuring under a number of other conditions—starvation, cyclic vomiting, sunstroke, and certain infectious diseases—the accumulation of keto acids formed from fatty acids is the predominating feature. In other types the increased concentration of hydrogen ions is largely due to the formation of sulphuric, phosphoric, lactic, and possibly other acids formed as a result of increased rate of metabolism, especially in overworked muscles or muscles affected by the toxins of infectious disease. The organism as a whole possesses in its alkali reserve and in its ability to form ammonia from the nitrogen of protein the power to neutralize a great amount of acid produced in the destruction of protein and fat and yet acidosis not infrequently develops with certain combinations of circumstances which are not yet understood. As a matter of fact the change in hydrogen ion concentration is probably but a part of the picture. It is quite likely that the damage, expressed as acidosis but caused by the underlying disorder of metabolism, is due not so much to the accumulation of acids as to the formation of other degradation products, poisonous but not acid in character, formed from amino-acid compounds and possibly from fatty acids as well, when the conditions are such that normal oxidative changes can not go on to the formation of harmless products. It is understandable that insufficient oxidation might result from—

(*a*) Inadequate aeration of the blood in the lungs.

(*b*) Inability of the blood to carry sufficient oxygen.

(*c*) Interference with the mechanism for transferring oxygen from the blood to tissue cells—deficiency of glutathione and such other compounds as may be required to effect the transfer.

(*d*) Excessive rate of metabolism in the tissues—overheating, excessive muscular work, infection.

(*e*) Insufficient insulin to effect the oxidation of carbohydrate, or lack of such other ferments as may be required for the splitting of proteins and fats.

With increasing acidosis originating in any manner the end result will be tissue asphyxiation, but when excessive metabolism in the muscles or inadequate supply of oxygen to the muscle cells is the underlying cause of acidosis the picture is one of asphyxiation throughout. The nature of poisonous degradation products that may be formed and enter the general circulation under such conditions is not known. This is a promising field for research in the light of the newer knowledge of cystine and of the part played by reactive sulphur as a detoxicating agent.

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METABOLISM IN OVERNUTRITION

Some people can overeat without increasing their weight, but, for practical purposes, the measure of overnutrition is excess weight. Height is often taken as the indicator of proper weight, provided an allowance is made for age and for some latitude in range above and below average figures. But even in the case of a middle-aged person it is not always true that he would be in a better state of health or that his expectation of life would be increased by reducing his weight to conform to the height-weight tables that are commonly used. In some cases, at least, considerable weight should be given to heredity, and the general physical make-up of the person can not be disregarded. Tables constructed from heights and weights of even a vast number of subjects without regard for other anthropometrical data contain figures that are in the nature of unweighted averages, and as such they potentially make for fallacious reasoning.

On the other hand, if the subject clearly was not overweight in earlier years a standard can be formulated for that individual from his or her previous weights and measurements, with due allowance of a few pounds for change in figure and increase in weight usually experienced after the age of 40 by persons of similar build and racial characteristics. An observant physician when examining a patient can hardly fail to detect the presence of excess fat. Probably nearly everyone who weighs more than he would if he were in the best possible condition is aware of the fact, even if not prepared to admit it. It is comparatively simple for the physician to judge that his patient should curb his appetite or, as the case may be, to endeavor to reduce his weight by a few pounds, but it is often difficult to say exactly how many pounds more than what would be optimum for him the patient actually weighs. Reduction to the figure indicated by a height-weight table might well be too great a reduction.

In some cases there is a considerable amount of generally distributed fat, and yet from a reasonable viewpoint it may be thought that the individual while admittedly living on a high plane of nutrition is not endangering his health thereby. That is a matter of unsettled opinion.

Figures which seem to indicate that fat people do not live as long as thin people are of course significant, but the statistics collected by life insurance companies can not be regarded as being altogether free from the statistical pitfalls of concealed classifications. Then, again, overnutrition is doubtless often associated with other factors that tend to shorten life—among other things, overindulgence in alcohol. Figures in sufficient volume with reference to particular degrees of overweight, well classified according

to different types of build and certain other class characteristics, are needed. The pronounced loss of weight that persons of advanced years have undergone, as evidenced by wrinkling of the skin, should be taken into consideration.

We need not doubt that obesity, at least as it commonly results from overeating, is something to be avoided. The important question for students of metabolism to settle is the amount of damage, if any, resulting from a high plane of nutrition that leads to the storage of a moderate amount of fat but not enough to make the individual conspicuous, pathetic, or comical.

Sherman, with reference to energy allowances for adults, remarks that a diet designed to maintain metabolism on a high energy level provides primarily for a large amount of muscular work. If the work is not performed and the food continues to be eaten and digested, storage, chiefly in the form of fat, may be expected whether the food eaten is carbohydrate, fat, or protein. Thus the store of body fat carried is the most reliable indication as to whether the amount of food habitually eaten is or is not properly adjusted to the amount of work performed.

It is to be remembered that storage of fat in itself modifies the food requirement. When an individual has increased his weight by storage of fat his total metabolism has increased, and especially more calories are required than formerly for the performance of any given amount of work. He has a heavier body to move and he burns more fuel in walking a mile, etc. If his daily intake of food remains constant, although excessive, he tends to reach a state of equilibrium, after which his weight will not increase. In other words, with every additional pound gained there is lessened likelihood that he will gain another unless he continues to increase his intake still more.

Sherman, like other investigators, is led to the statement that opinions differ somewhat as to the desirable degree of fatness as indicated by the relation of height to body weight. He refers to Hill's estimations including the proposition that a man 5 feet 8 inches in height should weigh not less than 128–135 nor more than 165–173 pounds, exclusive of the weight of clothing. Hill considers that a man whose weight exceeds the average by 15 to 30 per cent is "fat." Sherman then refers to the article by Brandreth Symonds, chief medical director of the Mutual Life Insurance Co., which appeared in the New York Medical Record, September 5, 1908, in which he presented the height and weight table compiled in 1897 by Dr. George R. Shepard for the Association of Life Insurance Medical Directors.

That table, which is widely referred to, is as follows:

Shepard's Height-Weight Table for Males at Different Ages

Based upon an analysis of 74,162 accepted male applicants for life insurance, as reported to the Association of Life Insurance Medical Directors, 1897

[Weight of clothing and height of shoes included]

Height		Age									
		15-24	20-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69
Ft.	*in.*										
5	0	120	125	128	131	133	134	134	134	131	......
5	1	122	126	129	131	134	136	136	136	134	......
5	2	124	128	131	133	136	138	138	138	137	......
5	3	127	131	134	136	139	141	141	141	140	140
5	4	131	135	138	140	143	144	145	145	144	143
5	5	134	138	141	143	146	147	149	149	148	147
5	6	138	142	145	147	150	151	153	153	153	151
5	7	142	147	150	152	155	156	158	158	158	156
5	8	146	151	154	157	160	161	163	163	163	162
5	9	150	155	159	162	165	166	167	168	168	168
5	10	154	159	164	167	170	171	172	173	174	174
5	11	159	164	169	173	175	177	177	178	180	180
6	0	165	170	175	179	180	183	182	183	185	185
6	1	170	177	181	185	186	189	188	189	189	189
6	2	176	184	188	192	194	196	194	194	192	192
6	3	181	190	195	200	203	204	201	198	......	......

Symonds's Height-Weight Table for Women at Different Ages

Based on 58,855 accepted applicants for life insurance (Sherman: Chemistry of Food and Nutrition)

Height		Age									
		15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Ft.	*in.*										
4	11	111	113	115	117	119	122	125	128	128	126
5	0	113	114	117	119	122	125	128	130	131	129
5	1	115	116	118	121	124	128	131	133	134	132
5	2	117	118	120	123	127	132	134	137	137	136
5	3	120	122	124	127	131	135	138	141	141	140
5	4	123	125	127	130	134	138	142	145	145	144
5	5	125	128	131	135	139	143	147	149	149	148
5	6	128	132	135	137	143	146	151	153	153	152
5	7	132	135	139	143	147	150	154	157	156	155
5	8	136	140	143	147	151	155	158	161	161	160
5	9	140	144	147	151	155	159	163	166	166	165
5	10	144	147	151	155	159	163	167	170	170	169

Symonds wrote in his original article that an individual is not considered overweight unless he carries more than 20 per cent above the standard weight for the height and age. For example, at age 40 the table indicates a weight of 150 pounds for a man 5 feet 6 inches tall. He would not be regarded as overweight until he had passed 180 pounds, which is 20 per cent more than the tabulated average.

Sherman remarks that the optimum is very near the average of the accepted applicants as shown in the tables, and that Symonds's

data therefore support the opinion that the average degree of fatness of healthy American people is just about the most advantageous fatness for them to maintain. He continues, "Whatever we accept as the ideal relation of weight to height, it is obvious that the proper standard for fuel value of the diet is that which will preserve the desired degree of fatness while sustaining the desired amount of activity. If good authorities differ in standards for fuel value, it is because, consciously or unconsciously, they contemplate different amounts of muscular activity or the maintenance of a different physique. The amount of food required per day to maintain a healthy adult at the desired body weight will vary considerably with age and size, and enormously with extremes of muscular activity."

It is, of course, true that anybody who eats less food than is required to satisfy *his* basal plus *his* work requirements will lose weight, but some individuals will not lose weight on a diet that would provide too little fuel value for others carrying about the same weight and having about the same work requirements. As pointed out by Strouse and Dye (Studies on the metabolism of obesity—Relationship between food intake and body weight in some obese persons; Archives of Internal Medicine, September, 1924), in some cases of obesity the tendency to accumulate and deposit fat seems to be entirely independent of any of the usual causes of increased weight.

DuBois wrote in 1924, "Obesity is perhaps more discussed by the laity and the public press than any other nutritional disorder, and the large amount of public interest is in marked contrast to the small amount of scientific information." Some individuals grow fat and it is not possible to say why they do, and many others who overeat greatly, if the quantity of food that will fatten most of their friends and relatives is a criterion, do not get fat. There are the lean and lanky individuals who "eat as much as a horse," so the saying goes, and yet to the casual observer they appear to be underweight rather than otherwise. It certainly can not be predicted that an individual will put on weight if he eats more food than he needs. He may metabolize on a sliding scale, holding his weight on a small daily intake of food and burning all he eats when large amounts are taken, with increased display of energy and production of total heat.

According to Strouse and Dye, excessive obesity is comparatively rare, yet both overeating and underexercise are common faults of mankind. Their conclusion is that the maintenance of body weight may be practically independent of the caloric balance, and that obesity may result from causes other than excessive food intake or

diminished energy expense. "The 'constitutional' obese and the healthy underweight may represent extremes of the same problem." They summarized the results of the studies discussed in their first paper as follows:

"1. The literature on obesity is reviewed to prove the existence of an entity, which for want of a better name is called constitutional obesity.

"2. Persons showing this predisposition show no interdependence between food intake, energy expense, and weight.

"3. Dietary studies of some new cases are given; also a clinical study of a healthy, very thin man is given.

"4. The data thus accumulated definitely prove that certain types of obese persons maintain their weight without regard to the usually accepted caloric balance."

Many persons maintain a constant weight for 20 and 30 or more years by simply following their appetites, and many others can avoid overweight only by careful attention to diet and frequent use of scales. DuBois makes the point that obesity is rarest in savage tribes where bathroom scales are unknown and skirts and trousers at a minimum. He also notes that it is not necessary to assume an interference of the ductless glands in normal men, although in pathological cases the effects of these glands are striking. He considers that it is possible, as a rule, for the body weight to be maintained at a constant level by a fairly delicate adjustment of the diet to metabolic requirements.

On the basis of present knowledge it is perhaps justifiable to conclude that most people, under the conditions of civilized life with fixed habitations, who are fat are so because they overeat, but that no inconsiderable number grow fat on a comparatively small intake of food while moderately active, and that some obese persons can not lose weight except by doing very hard work for many days or weeks on an extremely low diet with total fuel value of less than 1,000 calories daily, which would probably be less than 50 per cent of the calculated requirement according to the Lusk and DuBois standard. Not infrequently the predisposition to obesity can be observed in young children. In some cases the hereditary influence is apparent. In other cases the tendency may be attributed to unusual influence of endocrine secretions not similarly manifested by a parent.

Basal metabolism in obesity.—In many cases studied the heat produced by obese subjects under basal conditions per square meter of body surface has been found within normal limits. DuBois refers to 94 cases of obesity tabulated by Boothby and Sandiford. Eighty-one per cent of these were within 10 per cent of the average normal

rate; 95 per cent between −15 per cent and +15 per cent; 3 per cent were between −20 and −16; one subject was below −20 per cent; and one was about +16 per cent. DuBois concluded that constitutional obesity is not generally accompanied by any abnormality of metabolism striking enough to be demonstrated by present methods.

Strouse, Wang, and Dye in the second paper published by the group in Archives of Internal Medicine, September, 1924, concluded that neither excessive underweight nor excessive overweight is associated with a constant change in basal metabolism, and that obesity can not be caused by changes in the basal metabolism.

The rate of basal metabolism as determined for a fat subject can not be expected to give much information as to why he is fat. The rate of oxygen consumption while at rest, 14 hours after ingesting food, does not indicate how different in comparison with a person of normal weight the consumption of fuel is while work is being performed or during sleep. The subject may be storing little or no fat while the basal metabolic rate is being determined, and the production of heat resulting from the specific dynamic action of food is, of course, not taken into consideration.

Specific dynamic action of foods in obesity.—Wang and Strouse in a third paper, printed in Archives of Internal Medicine, October, 1924, reported the study made by them in this connection of obese subjects, under the title " The specific dynamic action of food." They had previously expressed the opinion that inasmuch as no one had been able to explain obesity on the basis of variations in basal metabolism, a theoretical explanation might be found in one of two ways: (*a*) An unusual use of food stuffs; (*b*) variation in energy expense by different persons performing the same task. They considered that the second assumption implied individual variations in the so-called specific dynamic action of food. The definition of specific dynamic power is involved. But it would seem that individual variations in the specific power of a given food to lead to increased production of heat might occur without necessarily being correlated either positively or negatively with unusually great expenditure of fuel for the performance of equal amounts of work.

Wang and Strouse studied the effects of protein, fat, and carbohydrate test meals on 12 obese subjects, 5 thin people, and 5 normal subjects. Protein showed very little specific dynamic action in the fat subjects. The thin people, on the contrary, showed a very high specific dynamic action of protein. Normal subjects followed much the same course as the thin people but to a lesser degree.

The specific dynamic action of carbohydrate was most marked in normal subjects. The obese subjects did not react uniformly, but

the average finding for the group indicated a lessened specific dynamic action of carbohydrate. There was not so much difference in the three groups as occurred when protein was ingested.

There was very little if any evidence of specific dynamic action of fat.

Carbohydrate metabolism probably is different in some respects in persons who have an unusual tendency to store fat. This would account for continued storage in spite of muscular activity. A lessened specific dynamic action of protein would be an influence constantly acting while the subject is not burning fuel for the performance of muscular work to reduce the amount of sugar burned and to increase the amount converted into fat. The storage of fat takes place in spite of increased expenditure of calories required by all activities of the body due to the increased weight of the subject.

If certain thin people are so constituted that they invariably burn any excess of food ingested beyond their requirements so that they can not be fattened, it is probable that certain obese subjects are examples of converse conditions.

Relationship between obesity and diabetes.—Joslin states, "No other condition rivals obesity in importance as a forerunner of diabetes, but a strenuous mental life is probably of some significance." Writers generally, he says, have observed the relationship to obesity, and Von Noorden not only emphasized the necessity of examining the urines of fat persons for sugar, but also suggested that examinations of the blood sugar of fat persons would disclose their approach to the disease when the urine was sugar free. But Joslin adds, "The closeness of the dependence of diabetes on obesity demands still more elucidation."

Statistical studies leave no doubt, in the case of mature adults at least, that a much greater percentage of persons who are overweight, according to the standard height-weight table, develop diabetes than of those who are underweight or normal, according to the table. Joslin quotes Mr. Mead of the Lincoln National Life Insurance Co. as finding that although constitutional diseases in general increase as age advances, and particularly as obesity advances, diabetes is partly an exception to the rule in that its incidence increases with age only in the fat, while in the thin it remains constant throughout life. The conclusion drawn from this observation is that diabetic patients, young and old, are akin. Joslin considers that diabetes is largely a penalty of obesity, and the greater the obesity the more likely is nature to enforce it. With regard to substandard weight patients, he says it would seem justifiable to formulate this diabetic law: "It is rare for diabetes to develop in an individual above the age of 22 years who is habitually underweight, and when it does so

develop the case will usually be found to be either extremely severe, extremely mild, or associated with a marked hereditary taint or degenerative stigmas." He continues, "The tendency to diabetes appears to be congenital. It is most intense in childhood, but escaping that period the individual is less and less likely to acquire the disease if he remains underweight, whereas in the obese the tendency finds a fertile soil. In the fat the predisposition may be no greater, but the external cause is more provocative."

Haven Emerson and Louise D. Larimore, in a contribution to the epidemiology of diabetes based chiefly on mortality statistics, 1924, pointed out that the increase in the incidence and death rate from diabetes in the United States, and in New York City in particular, has been more rapid than that of any other disease for which we have records in the last 50 years. The increase, while affecting all ages to some degree, has been most marked among females at all ages, and among both men and women over 35 years of age in particular.

They refer to reports by the Bureau of Animal Industry, United States Department of Agriculture, indicating that the annual per capita consumption of meat in the United States has fallen in the last 15 years from 179 to 155 pounds, the reduction having been offset by an increase in the use of cereals, sugar, milk, and fruits. In Australia, where the diabetes death rate appears to be low, the annual consumption of meat per capita is reported as 250 pounds. They consider the recorded per capita consumption of sugar as a sign of the tendency to excesses of foods of all kinds beyond the needs of persons for foods in proportion to expenditure of energy at the different ages of life, and in particular in the later decades. They studied the estimated per capita consumption of sugar per annum over certain years in the United States, Great Britain, and France, in relation to diabetes death rates, and concluded that rises and falls in the sugar consumption are followed with fair regularity within a few months by similar rises and falls in the death rates from diabetes, the changes during the period of the World War being particularly striking.

It is not surprising that such correlation should be found. Several factors at least must ordinarily be involved in causing diabetes. The diabetics in a population group and those in danger of becoming diabetics might well be expected to suffer when economic and other conditions lead to a general increase in the consumption of foods, especially foods rich in carbohydrate. That overnutrition, or as Emerson and Larimore put it, superalimentation overfatiguing the function of sugar tolerance, is often a link in the causal chain may not be doubted. However, it is clear that neither

superalimentation alone nor constitutional obesity with a moderate intake of food is an indispensable link in the chain, for diabetes does develop sometimes in thin subjects who have not overeaten. It would seem logical at the present time to consider that the indispensable part of the cause of diabetes is inherited or acquired subnormal ability to oxidize carbohydrate. That probably means solely the inability to secrete insulin in sufficient quantity. As a rule, when the defect is marked, severe diabetes occurs early in life, although, as contemplated in Joslin's law, young subjects, even children, may have the disease in mild form. In such cases the specific dynamic power of carbohydrate and also of protein may be found less than normal and yet because of youth and other factors the patient tends to emaciate rather than to grow fat.

A phenomenon preceding another is not necessarily the cause or a part of the cause of the latter. Both phenomena may have a common cause. The fact that storage of fat often precedes the development of diabetes does not necessarily mean that overeating is often the cause of the disease. That may or may not be true. It is important to know just what the relationship is between "superalimentation" and diabetes. The work of Strouse, Dye, and Wang, referred to above, is interesting in this connection. Experimental work and statistics more suited to analytical study than those at present available are much needed.

It is particularly desirable to know what the comparative danger of developing diabetes is for persons who overeat but remain thin. for those who put on weight primarily as the result of the widespread habit-combination of overeating and underexercising, and finally for those in which the underlying cause of obesity is inherited or acquired limitation of the carbohydrate oxidizing power. If the Wang and Strouse findings are borne out by further investigations, it would seem reasonable to conclude that some persons have such a make-up with regard to endocrine secretions that proteins ingested by them manifest reduced specific dynamic power and likewise ingested carbohydrate, and that such individuals are prone to deposit fat, especially with any increase in the diet above energy requirements. Lacking full power to oxidize carbohydrate they are very likely predisposed to diabetes from the beginning. The fact that diabetes is rare in thin persons in the older age groups seems to indicate that "superalimentation" is not by itself a cause, although overfeeding in the case of a person having limited power to oxidize carbohydrate might well be expected to increase the probability that the disease will develop.

More and better statistical evidence is necessary before the conclusion is justified that the power of burning carbohydrate is reduced

by growing fat through overeating, so far as normal subjects are concerned; that is, those who have normally functioning glands producing internal secretions and particularly adequate secretion of insulin.

Dietary considerations in obesity.—This is not the place to discuss clinical methods, but certain principles of nutrition may be mentioned. To reduce weight it is of course necessary to reduce the total fuel value to less than the number of calories required to meet the total energy requirement, in order that the patient's own fat may be drawn upon as additional fuel. In so doing it is important to see that foods which are good sources of vitamins and minerals are eaten in sufficient quantity to meet the requirements. Fortunately, fruits and green vegetables which answer these purposes well, have comparatively low fuel value. It is also important to make sure that the protein intake, reduced somewhat as it may be, is of high biological value. Milk contains relatively much protein of the best growth promoting qualities. There appears to be no good reason for reducing the daily protein intake to less than 0.5 gram per pound of body weight, although 100 grams should be enough even if the patient weighs more than 200 pounds. With less than 200 pounds it is hardly necessary to reduce the protein below 75 grams.

The carbohydrate component in the diet had best not be reduced so low as to cause manifestations of beginning acidosis in cases where the patient responds readily to the restricted diet and burns his own fat freely. When so-called constitutional factors are involved it may be necessary to reduce the food intake to a very low level before the patient begins to lose weight, and in such cases when body fat is burned there may be less than one oxidizing molecule of glucose for every molecule of fatty acid oxidized. Current literature indicates that it is getting to be a common practice to give sodium bicarbonate as a routine precaution to obese patients while undergoing reduction. While it is always well to keep the alkali reserve of the organism in mind and plan the diet accordingly, it is doubtful if it is good for the patient to lose a few pounds in weight at the cost of inducing a sufficient degree of acidosis to require the independent use of alkali. When heroic deprivation of food is not required to effect loss of body fat, it would seem more rational to adjust the food to a low and long-continued rate of loss not likely to induce acidosis or result in deficiency of any essential dietary element. It is better for the moderately overweight individual to adhere to a thoroughly well-balanced diet, by simply eating less food, reducing the total fuel value without changing the proportion of proteins, fats, and carbohydrates.

(*To be continued*)

REPORT OF AN EPIDEMIC OF CEREBROSPINAL FEVER AT THE UNITED STATES NAVAL TRAINING STATION, SAN DIEGO, CALIF., DECEMBER, 1925–JANUARY, 1926

The outbreak comprised three cases in December, 1925; eight cases in January, 1926; and one case late in March. Sporadic cases occurred in May and June. Diagnosis in all cases was confirmed by laboratory procedures.

The first case developed December 4, 1925, in the person of a recruit housed in the incoming detention unit. In that unit the men were quartered in tents, six men to a tent. The patient enlisted in Portland, Oreg., and arrived on the station November 11, 1925.

Quarantine was immediately imposed upon the incoming detention camp, containing some 430 recruits, and no unnecessary mingling was permitted in that camp. Drills and exercises were reduced to a minimum and athletic contests prohibited. All recruits were required to wear heavy underwear and blues. Antityphoid inoculations were discontinued, mess gear was sterilized, soap and paper towels were provided in wash rooms, and every man was required to wash his hands before meals. Effective steps were taken to prevent promiscuous spitting and each tent was provided with a spittoon containing a disinfectant solution. All towels and handkerchiefs were collected daily and sterilized.

The second case developed December 6, 1925. The patient was also a recruit in the detention unit. He was quartered in tent 14, whereas the first patient had been living in tent 16. He enlisted in Kansas City, Mo., and had been on the station 12 days when attacked.

The third man attacked developed symptoms of the disease the following day, December 7, 1925. He enlisted in San Francisco, Calif., and had been on the station seven days. He was quartered in tent 10 in the detention camp.

The recruits in the incoming detention camp, about 430 in number, were from widely separated parts of the United States and none had been on the station for more than a short time. It was the opinion of the senior medical officer that these three patients were exposed to a common focus of infection and that the second and third cases were not secondary to the first. However, it was not possible to trace the source of infection.

The men in the detention camp were housed in tent cubicles, 16 feet square containing six men each, sleeping on cots. The floor area per man was therefore 42.66 square feet, whichc is considerably less than the Bureau of Medicine and Surgery considers proper for barracks—50 square feet per man.

There were a number of points in the camp where contact occurred between recruits from different tents, as, for example, in common showers and wash rooms, as well as in a building 35 by 80 feet with upper sides open and closed over only by canvas in which "movies" were held every evening. The floor of this building is always dusty because of dirt tracked in, and it is hardly sufficient in size for the purpose. Although the recruits might have been in contact with all others in the detention camp they had not been in contact with other persons outside. Liberty is not granted recruits in detention.

CARRIERS

The throats of all men in the detention camp were swabbed for cultures. Sixteen carriers were found and these were transferred to the United States Naval Hospital, San Diego, Calif. The carriers came from tents as follows:

Tent	Carriers	Subsequent cases of cerebrospinal fever	Tent	Carriers	Subsequent cases of cerebrospinal fever
3	1	0	14	1	0
4	1	0	15	1	1
5	1	0	17	1	0
6	2	0	33	1	0
10	3	0	Headquarters building (member of ship's company)	1	0
11	3	1			

No carriers were found among men who had been isolated as known contacts with any of the three men who had already developed cerebrospinal fever and none of these contacts subsequently developed the disease. The contacts as well as carriers were sent to hospital for observation, and after return from the hospital one of the contacts was found to be a carrier, although previously his cultures had been negative. No case developed among men who had been tent mates with carriers before they were detected.

No further cases having developed, quarantine was raised December 22, 1925, 14 days after development of the last case, except for tent mates of men who had been found to be carriers, for whom quarantine was extended to a period of 14 days from the date of last contact with a carrier.

The first man to develop the disease stated that meningitis had been present in Portland, Oreg., just before he enlisted there. One of the 16 carriers also came from that city, arriving at the station November 25, 1925, 12 days after the patient arrived but 11 days before he was taken sick. They were not tent mates. The carrier in

question subsequently became infected, developing symptoms of cerebrospinal fever while in hospital, probably as a result of contracting catarrhal fever or influenza.

On January 10, 1926, 19 days after quarantine was raised, or 34 days after transfer of the third case to hospital, a case was discovered on the main station. The patient was a member of Company B–6, which had been formed of recruits who had been quarantined in the detention unit in December. His throat cultures were negative in December. He became ill with symptoms of catarrhal fever January 10 and was transferred to hospital with that diagnosis, cerebrospinal fever not being suspected. The following day the diagnosis of cerebrospinal fever was made and confirmed.

Upon notification of the disease Company B–6 was quarantined and all members were cultured. Two carriers were found and transferred to hospital. No further cases having developed, this company was released from quarantine January 23, 1926.

The fifth case of the outbreak developed January 21, 1926, in a different company, C–3, but it also was one of those formed of recruits quarantined and cultured in December. The company was again cultured; four carriers were detected.

The following day, January 22, 1926, the hospital reported that two men who had been sent from the training station with acute bronchitis seven and nine days before had just developed cerebrospinal fever. These men also had been among the 430 recruits originally quarantined.

January 24, 1926, a recruit was transferred to hospital with symptoms suggestive of cerebrospinal fever. Affirmative evidence was obtained later. C–1, the company to which this man belonged, was again cultured and three carriers were found.

January 25, 1926, two more cases developed among patients who had previously been transferred from the detention camp—one on January 15, with acute bronchitis, and the other, January 17, with catarrhal fever.

January 29, 1926, a patient in the hospital who had been admitted from the training station eight days before, with acute bronchitis, developed cerebrospinal fever. So far as known he had not been a carrier.

A man transferred to hospital as a carrier from Unit T–1, February 1, 1926, and later discharged after negative culture had been obtained, showed symptoms of meningitis March 24, 1926, and the meningococcus was found in his cerebrospinal fluid the following day. A few days before this man became ill with meningitis he asked to have his tonsils removed. His health record indicated that he had been a carrier; so, as a precautionary measure, a post nasal

culture was made. He began to feel sick shortly after the throat was swabbed and was transferred to hospital as a probable case of cerebrospinal fever before the laboratory report was received.

April 30, 1926, one of the 16 men who were found to be carriers in December, 1925, was suspected of having cerebrospinal fever. He was immediately transferred to hospital where the diagnosis was confirmed the next day. He had been discharged from the hospital January 22, 1926, after being isolated as a carrier for 42 days. He was admitted to the sick list February 24 with catarrhal fever and transferred to hospital February 27. His acute respiratory infection was complicated with broncho-pneumonia. He recovered and was discharged to duty March 23, 1926. As indicated above he developed cerebrospinal fever seven days later.

Although the epidemiological report furnished by the training station concluded with a discussion of the above-mentioned cases, morbidity reports since received in the Bureau of Medicine and Surgery indicate that three more cases of cerebrospinal fever occurred on the station in May, and one in June, 1926, making in all, 16 cases.

Weather Conditions During the Epidemic

When the cases occurred in December the weather had been unusually dry for a long time. The detention camp is not paved. The drill field and part of the space between tents is bare, dry, sandy, clay soil, and there was a great deal of dust when the outbreak began. In January similar conditions prevailed.

Incidence of Other Communicable Diseases

When the epidemic began in December, acute respiratory infections were already very prevalent on the station. All three of the recruits who had cerebrospinal fever in December had coryza and other symptoms of catarrhal fever before manifesting signs of meningitis. Early recognition of the latter conditions resulted from the practice of making routine blood counts in all cases that for any reason appeared serious.

The senior medical officer of the station wrote in January that there had been some doubt as to whether the cases diagnosed as catarrhal fever might have been influenza. At any rate it was his opinion that recruits affected with catarrhal fever or colds were undoubtedly predisposed to invasion by the meningococcus. It is of course impossible to determine whether any or all of the cases recorded as acute bronchitis and catarrhal fever were really cases of influenza. It appears that they were not essentially different in their clinical manifestations, duration, severity, and complica-

tions from other cases of acute respiratory infections occurring throughout the year. It is now a matter of record that influenza was unusually prevalent last winter. During the winter and spring months epidemics occurred in California as well as in many other parts of the United States.

A CASE OF FOOD POISONING CAUSED BY EATING MUSHROOMS OF A POISONOUS SPECIES

The following information was furnished in conformity with the requirements of the Bureau of Medicine and Surgery questionnaire form for reporting cases of food poisoning:

I. The patient was living in quarters on the station with his family, performing duty as a pilot of one of the passenger tugs between this station and San Francisco.

II. Mushrooms were eaten by him Sunday, April 11, at 6 p. m., as a sauce for pork chops. Other members of his family who were present did not eat any of the mushrooms because the patient had gathered them and they did not have confidence in his ability to identify edible mushrooms.

III. Saturday morning the breakfast of the family consisted of corn flakes and fried eggs. A similar breakfast was eaten Sunday morning. The menus for the other meals could not be obtained except that of the Sunday dinner when pork chops with mushrooms in a sauce were served in addition to potatoes and canned peas. The other members of the family ate of the same foods that the patient did except for the mushrooms, as has been stated.

IV. The first symptoms appeared at 10.30 a. m. Monday, April 12, 16 hours after eating the mushrooms.

V. No others were affected.

VI. No other persons ate mushrooms. Two other persons ate of the other food served at the same time the suspected food was eaten and the patient's wife and child ate of the same food that he ate at meals intervening between the consumption of the mushrooms and the appearance of the first symptoms of poisoning.

VII. (*a*) The first indication of illness was diarrhea.

(*b*) The onset was sudden in that a severe watery diarrhea began without premonitory symptoms 16 hours after the suspected food was eaten.

(*c*) There was no previous disease or symptom.

(*d*) The patient had been in excellent condition prior to his poisoning.

(*e*) The medical officer was called about 24 hours after the appearance of the first symptoms.

(*f*) The patient had the general appearance of one who is severely ill.

(*g*) He had continuous abdominal pain accompanied by exacerbations of more intense colic.

(*h*) The patient vomited twice during his illness of seven days. The first vomiting occurred about 24 hours after he had eaten the mushrooms. He vomited again 24 hours after his first attack of vomiting. The vomitus expelled on both occasions according to statement of patient was of a dark bloody character, apparently of a hemoglobinous nature.

(*i*) There was moderate abdominal colic but no distention.

(*j*) There was a marked diarrhea that persisted for 60 hours. It was not controlled by bismuth subnitrate or morphine. The stools were watery, frequent, and copious. No blood or hemoglobin coloring was seen in any of the stools.

(*k*) There was no chill, but a cold perspiration developed soon after the initial symptoms and persisted for 36 hours.

(*l*) After the cold perspiration ceased a fever occurred on the third day of his illness and remained present for 24 hours. It varied from 100° F. to 101° F.

(*m*) There was no headache.

(*n*) Soreness occurred over the abdomen only. There was no general aching.

(*o*) There was sudden and marked prostration that persisted for several days after the relief of all other symptoms.

(*p*) His mouth was dry throughout his illness. There was no excessive salivary secretion at any time or bitter taste in the mouth.

(*q*) There were no ocular symptoms or signs.

(*r*) Marked flushing of the face appeared during the third day of the illness and lasted for 12 hours.

(*s*) When first examined by a medical officer the pulse rate was sixty. The rhythm was regular and the pulse was of strong quality. The slow pulse continued for the next 48 hours, varying slightly from 60 to 53. After that period the rate increased to 100, with the upper limit 116. The character was weak but the rhythm remained regular. The blood pressure was not taken.

(*t*) His respirations remained normal throughout his illness.

(*u*) There was no skin eruption; but marked flushing of the face occurred as noted in a previous answer and a moderately intense jaundice appeared on the fourth day of the illness, disappearing 36 hours later. No blood count was made.

VIII. The urine was negative except for dark color and albumin which disappeared on the fifth day. No culture was made.

IX. No chemical or bacteriological examinations were made of the vomitus or stools.

X. The mushrooms were gathered on the station by the patient who had had very little experience in the identification of the edible varieties although he had gathered and eaten them before without ill effects.

XI. Canned goods were not suspected.

XII. None of the suspected food was obtainable.

XIII. The food was eaten by the patient at his quarters and he had not eaten in any other place for several days previous to his illness.

A brief summary of the case is as follows: Sixteen hours after eating mushrooms of unidentified species the patient became ill with a severe water diarrhea. This was soon followed by abdominal pain, marked prostration, and cold sweating. On two occasions he vomited stomach contents of a hemoglobinous character. His pulse was much retarded during the first two days of his illness, after which the pulse rate increased and there was a moderate fever for one day. The diarrhea could not be controlled by medicine but lessened on the third day and stopped on the fourth day when improvement began in the other symptoms. Jaundice of moderate intensity developed on the fourth day and lasted for 36 hours. Albuminuria was present during the acute stage of his illness and disappeared during convalescence. Early marked prostration was observed. It persisted after all other symptoms had disappeared.

OIL OF WINTERGREEN A CAUSE OF FATAL POISONING—TOXICITY OF METHYL SALICYLATE

Recently an officer died with acute poisoning a few hours after drinking an undetermined quantity of oil of wintergreen. The time elapsing between ingesting the poison and death was not recorded.

When seen by the medical officer he was unconscious, cyanotic, and apparently moribund. The pulse could not be counted; the pupils were contracted and respirations were stertorous. He died a few minutes later.

Post-mortem examination revealed hemorrhages in the mucous membrane of the stomach and an appearance of acute inflammation at the pyloric end, where there was an area 2 inches wide encircling the stomach denuded of mucous membrane. This had the appearance of having been caused by caustic material. The esophagus was hemorrhagic and inflamed. The cut surfaces of the lungs had the odor of oil of wintergreen, indicating absorption into the general circulation. Apparently the brain was not examined. From the symptoms, it is not unlikely that intense congestion and small

hemorrhages would have been found as in cases of acute arsenic poisoning of the cerebral type, or the acute hemorrhagic encephalitis cases which sometimes follow the administration of arsphenamine or neoarsphenamine.

It is probable that comparatively few physicians realize how great the danger of fatal poisoning is when oil of wintergreen is swallowed in quantities greater than usual therapeutic doses. According to Wetzel and Nourse, who have reviewed the cases so far recorded in the literature, absorption of less than 15 c. c. has repeatedly resulted in death. Vascular changes are the most prominent post-mortem findings. Multiple subserous hemorrhages of the brain, lungs, and kidneys are produced. In some cases extensive subdural hemorrhage has been found.

Wetzel and Nourse, writing in the Archives of Pathology and Laboratory Medicine for February, 1926, review 17 cases. The time of appearance of symptoms after ingestion varied from 20 or 30 minutes to 15 hours. Recovery followed the ingestion of 15 c. c. in three instances although the symptoms were alarming. In one fatal case symptoms appeared three hours after ingesting 12 c. c. In four of the cases listed, the quantity ingested was reported as 30 c. c. Two of these four cases were fatal and the other two patients recovered after several days during which there were nerve symptoms and acidosis. In one of the two 30 c. c. fatal cases, symptoms appeared 15 hours after ingestion and the time was not recorded in the other. In the cases terminating in recovery, symptoms appeared early—one-half hour and one hour.

Six soldiers were accidentally poisoned by drinking wintergreen tea. All recovered. The symptoms were vertigo, weakness, and vomiting.

In fatal cases, after ingesting quantities of from 15 to 30 c. c., the duration of life appears to have been from 15 to 30 hours. All reported cases in which convulsions occured were fatal.

Wetzer and Nourse refer also to three fatal cases of sodium salicylate poisoning. In one, symptoms appeared 72 hours after ingesting 34 grams. The patient was a girl 17 years old. In one, symptoms of poisoning developed after 10 weeks' treatment for rheumatic endocarditis, the daily dose being 20 grams for a 5-year old child. The other patient was a girl 4 years old. The amount ingested was reported as 360 grams. Death followed after three days of acidosis, coma, and air hunger.

In two reported cases of methyl salicylate poisoning, oil of wintergreen was mistaken for castor oil. One patient died in spite of prompt treatment: the other recovered.

CASE FATALITY RATES BY MONTHS FROM CERTAIN COMMUNICABLE DISEASES IN DETROIT, MICH.

The following useful figures were published by the health department of the city of Detroit in its weekly health review, June 10, 1926.

The editor remarked that while the highest combined fatality rate for all the diseases listed occurs in January, as might be expected, several of the diseases individually appear to be most fatal in June and July, which is somewhat surprising.

He continues, " While it is impossible to assign any definite reason for these high rates in summer, we are inclined to believe that they are in part due to an actually high fatality rate and in part to an artificial situation brought about by the fact that in the summer there is quite a possibility of mild cases being missed through failure of a parent to suspect a communicable disease. Obviously these cases would not be reported as cases and would artificially raise the case fatality rate. Many of these cases would have been detected by the school nurses during the cold months when schools are in session. The actual increase in the fatality rate would seem to result from parents failing to call the physician until late. In the colder months parents are more on the lookout for communicable diseases while in the warm months a rash, sore throat, or cold may be more or less disregarded or made little of by the parents until the child is acutely ill. The delay in calling the physician until this late date quite naturally decreases the patients' chances of getting well. It is also unfortunately true that during the warm months parents do not observe the physician's instructions as well as at other times of the year. 'It was such a nice warm day that I simply couldn't keep Johnny indoors in bed,' is the answer which the physician all too often receives from the parent."

Case fatality rates for certain diseases in Detroit (period covered from June 1, 1922, to June 30, 1925)

[Deaths per 100 cases]

	Diphtheria	Scarlet fever	Smallpox	Measles	Whooping cough	Erysipelas	Lobar pneumonia	Bronchopneumonia	Total
July	9.26	2.95	14.03	3.31	2.12	8.57	68.66	54.54	9.56
August	9.06	3.98	20.58	.98	3.66	23.33	66.92	65.71	12.77
September	6.43	1.02	5.55	--------	3.33	20.45	67.44	73.00	14.57
October	6.74	1.92	17.64	2.29	2.99	10.40	62.27	59.87	14.29
November	5.58	.86	--------	1.36	2.21	18.51	65.49	47.86	12.57
December	7.29	1.58	--------	.74	1.94	16.27	50.97	47.86	13.68
January	5.46	1.62	4.0	1.35	1.76	22.0	55.60	48.18	16.56
February	8.17	1.35	1.72	1.81	2.81	8.33	54.23	48.14	16.51
March	8.24	1.90	1.79	1.26	1.82	11.61	53.42	54.85	14.07
April	9.05	2.02	5.88	1.42	2.86	13.33	56.68	49.24	13.03
May	10.66	1.63	20.58	1.61	3.08	11.49	54.47	38.82	11.56
June	10.87	1.14	17.34	2.16	3.73	7.44	49.49	42.75	10.05
Total	7.63	1.67	8.89	1.66	2.78	13.15	56.20	49.32	13.26

AN INCREDIBLE REPORT OF ATMOSPHERIC CONDITIONS IN A SHIP'S ENGINE AND FIREROOMS DURING FULL-POWER TRIAL

The medical officer's report of the trial in question contained the following statements of dry-bulb and wet-bulb temperature readings:

	Dry bulb	Wet bulb	Outside temperature
	°F.	°F.	°F.
No. 2 fireroom	136.4	135.8	81
No. 3 fireroom	129.0	128.6	80

If he had not commented favorably upon these temperatures which stand for intolerable atmospheric conditions, it might have been assumed that he delegated the task of recording temperatures to some one who had not been trained to obtain a correct wet-bulb thermometer reading and that he did not scrutinize the figures carefully enough to note that at the high atmospheric temperatures recorded, 136.4° F. and 129.2° F., the differences between the dry-bulb and wet-bulb readings are each set forth as 0.6° F., which would indicate that the relative humidity was more than 98 per cent in both compartments. Inasmuch as experiments conducted by Surg. R. R. Sayers, of the United States Public Health Service, for the Bureau of Mines showed that men could withstand exposure to saturated air at a temperature of 100° F. for only a few minutes even while sitting completely at rest, the effect of nearly saturated air at temperatures of 129° to 136° F. can be imagined.

The medical officer indicated that he had studied the figures he presented. He observed, "The above temperatures indicate favorable working conditions, especially as to humidity. No special contamination of air was noted except the coal dust in fireroom and oil odor in engine room spaces."

Medical officers are advised to exercise themselves sufficiently to insure the incorporation of correct data in Full-Power Trial Reports, and if necessary learn how to use a sling psychrometer correctly. These reports are subjected to critical study in the Bureau of Medicine and Surgery.

HEALTH OF THE NAVY

The general admission rate, based on statistical returns for diseases and injuries occurring in April, May, and June, was unusually low. The rate was 476 per 1,000. The corresponding rate for the first quarter of the year was 546. Based upon experience in previous years, the expected rate from all causes for the second quarter of the year would be 590 per 1,000.

The admission rate for disease was only 420, and the rate for accidental injuries was a little lower than for equal periods of time in previous years—51 per 1,000, as compared with rates of from 60 to 70 in earlier years.

Influenza, colds, and acute tonsillitis caused comparatively few admissions.

Eight cases of cerebrospinal fever were reported during the quarter. Four cases developed at United States naval training station, San Diego, Calif., in May and one in June. One case occurred at United States naval training station, Great Lakes, Ill., in April and two in May. Two more cases developed in July at that station.

The Navy was, contrary to expectations, comparatively free from measles in all three months of the quarter.

The report of a fatal case of smallpox which occurred in February in the person of an officer attached to the U. S. S. *Monocacy* serving in China was received too late to be included in the summary for the first quarter of 1926.

Food-poisoning cases continue to be reported, especially by forces afloat, in considerable numbers. Fewer cases are probably occurring in the Navy now than in previous years, but, inasmuch as a questionnaire form for an epidemiological report is sent out in all cases upon the receipt of a morbidity return notifying food poisoning, many mild cases of brief duration which formerly would not have been reported are now recorded. One fatal case of food poisoning, caused by fried oysters, occurred in Washington, D. C., in April. The patient, an officer, ate fried oysters at a restaurant in company with two others, who were also poisoned, but recovered after several hours. Cultures made from stomach contents during postmortem examination revealed the presence of bacilli belonging to the meat-poisoning group—*B. paratyphosus B.*

TABLE No. 1.—*Summary of morbidity in the United States Navy and Marine Corps for the quarter ended June 30, 1926*

	Forces afloat	Forces ashore	Marine Corps	Entire Navy
Average strength	74,690	38,186	19,411	112,876
All causes:				
Number of admissions	7,692	5,731	2,482	13,423
Annual rate per 1,000	411.95	600.33	511.46	475.67
Disease only:				
Number of admissions	6,772	5,088	2,198	11,860
Annual rate per 1,000	362.67	532.97	452.94	420.28
Communicable diseases, exclusive of venereal disease:				
Number of admissions	1,682	1,971	740	3,653
Annual rate per 1,000	90.08	206.46	152.49	129.45
Venereal diseases:				
Number of admissions	2,939	669	442	3,608
Annual rate per 1,000	157.39	70.08	91.08	127.86
Injuries:				
Number of admissions	792	639	283	1,431
Annual rate per 1,000	42.41	66.94	58.32	50.71
Poisoning:				
Number of admissions	128	4	1	132
Annual rate per 1,000	6.85	.42	.21	4.68

Table No. 2.—*Deaths reported, entire Navy, during the quarter ended June 30, 1926*

		Navy			Marine Corps		Nurse Corps	Total
		Officers	Midshipmen	Men	Officers	Men		
Average strength		8,153	1,535	83,300	1,162	18,246	480	112,876
Causes—Diseases								
PRIMARY	SECONDARY OR CONTRIBUTORY							
Abscess, psóas	Septicemia			1				1
Anemia, pernicious	Pneumonia, broncho			1				1
Appendicitis, acute (operated).	Peritonitis, acute general.			1				1
Appendicitis, chronic (operated).	Paralytic ileus			1				1
Do	Peritonitis, acute general.			1				1
Carcinoma pancreas and duodenum (operated).	Tuberculosis, general miliary.			1				1
Cerebrospiral fever	None			1				1
Do	Pneumonia, lobar			1				1
Cholecystitis, acute	Peritonitis, acute general.	1						1
Cirrhosis of liver	None			1				1
Encephalitis, lethargic	None					1		1
Gall stones (operated)	Dilatation, stomach, acute.	1						1
Hemorrhage, pons	None			1				1
Hodgkin's disease	None			1				1
Lukemia, acute, lymphoblastic.	None			1				1
Mastoiditis, acute	None					1		1
Nephritis, chronic	Endocarditis, chronic					1		1
Do	Nephritis, acute					1		1
Pneumonia, broncho	None	1						1
Pneumonia, lobar	None			1				1
Psychosis, manic depressive	Starvation			1				1
Smallpox	None	1						1
Syphilis	Poisoning, neoarsphenamine, acute.			2				2
Tuberculosis, acute pulmonary, pneumonic.	None			1				1
Tuberculosis, chronic pulmonary.	Tuberculosis, peritoneum.			1				1
Ulcer, duodenum	Dilatation, stomach			1				1
Total for diseases		4		19		4		27
Causes—Injuries and Poisonings								
Burns, multiple	None			1				1
Do	Pneumonia, lobar			1				1
Fracture, simple, skull	None			1		1		2
Fracture, pelvis	Rupture, traumatic, urinary bladder.			1				1
Hemorrhage, traumatic, rupture of aorta.	None					1		1
Intracranial injury	None			2				2
Do	Hemorrhage, traumatic, cerebral.			1				1
Do	Wound, lacerated, scalp			1				1
Injuries, multiple, extreme	None			4		5		9
Injuries, multiple, extreme	Hemorrhage, traumatic, rupture, spleen.			1				1
Rupture, traumatic, right kidney (soccer).	None					1		1
Strangulation, neck, rope [1]	None			2				2
Wound penetrating brain [1]	None					1		1
Wound, punctured, brain	None					2		2
Wound, punctured, abdomen	Hemorrhage, abdominal					1		1
Drowning	None			4				4
Poisoning, acute, food (oysters).	None			1				1

[1] Suicidal.

TABLE No. 2.—*Deaths reported, entire Navy, during the quarter ended June 30, 1926*—Continued

		Navy			Marine Corps		Nurse Corps, nurses	Total
		Officers	Midshipmen	Men	Officers	Men		
CAUSES—INJURIES AND POISONINGS—Continued								
PRIMARY	SECONDARY OR CONTRIBUTORY							
Poisoning, acute (methyl salicylate).	None				1			1
Total for injuries and poisonings				20	1	12		33
Grand total		4		39	1	16		60
Annual rate per 1,000, all causes		1.96		1.87	3.44	3.51		2.13
Annual death rate per 1,000, disease only		1.96		.91		.88		.96
Annual death rate per 1,000, drowning				.19				.14
Annual death rate per 1,000, injuries				.72		2.63		.96
Annual death rate per 1,000, poisoning				.05	3.44			.07

STATISTICS RELATIVE TO MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

The following tables were constructed with figures taken from monthly reports submitted by boards of review at naval training stations:

Cumulative data

	Number	Per cent of recruits received	Per cent of recruits reviewed
Jan. 1 to Dec. 31, 1925			
All naval training stations:			
Recruits received during the period	9,385		
Recruits appearing before board of review or medical survey	688	7.33	
Recruits recommended for discharge from the service	465	4.95	67.59
April, May, June, 1926			
U. S. naval training station, Hampton Roads, Va.:			
Recruits received during the period	578		
Recruits appearing before board of review or medical survey	23	3.98	
Recruits recommended for discharge from the service	23	3.98	100.00
U. S. naval training station, Great Lakes, Ill.:			
Recruits received during the period	647		
Recruits appearing before board of review or medical survey	49	7.57	
Recruits recommended for discharge from the service	24	3.71	48.98
U. S. naval training station, San Diego, Calif.:			
Recruits received during the period	1,409		
Recruits appearing before board of review or medical survey	66	4.68	
Recruits recommended for discharge from the service	43	3.05	65.15
U. S. naval training station, Newport, R. I.:			
Recruits received during the period	861		
Recruits appearing before board of review or medical survey	87	10.10	
Recruits recommended for discharge from the service	28	3.25	32.18

ADMISSIONS FOR INJURIES AND POISONING, SECOND QUARTER, 1926

The following table, indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during the second quarter, 1926, is based upon all Form F cards covering admissions in those months which have reached the bureau:

	Admissions, April, May, and June, 1926	Admission rate per 100,000 per annum	Admission rate per 100,000, year 1925
INJURIES			
Connected with work or drill	735	2,605	3,343
Occurring within command but not associated with work	489	1,733	2,001
Incurred on leave or liberty or while absent without leave	207	733	1,049
All injuries	1,431	5,071	6,393
POISONING			
Industrial poisoning	25	89	25
Occurring within command but not connected with work	106	376	490
Associated with leave, liberty, or absence without leave	1	3	16
Poisoning, all forms	132	468	531
Total injuries and poisoning	1,563	5,539	6,924

Percentage relationships

	Occurring within command				Occurring outside command	
	Connected with the performance of work, drill, etc.		Not connected with work or prescribed duty		Leave, liberty, or a. w. o. l.	
	April, May, and June, 1926	Year, 1925	April, May, and June, 1926	Year, 1925	April, May, and June, 1926	Year, 1925
Per cent of all injuries	51.3	52.3	34.2	31.3	14.5	16.4
Per cent of poisonings	18.9	4.7	80.3	92.2	.8	3.1
Per cent of total admissions, injury and poisoning titles	48.6	48.6	38.1	36.0	13.3	15.4

Poisoning by a narcotic drug or by ethyl alcohol is recorded under the title "Drug addiction," or "Alcoholism," as the case may be. Such cases are not included in the above figures.

The following cases, selected from April, May, and June reports, are worthy of notice from the standpoint of accident prevention:

Open hatch unguarded.—A man fell through an unguarded and unlighted hatch at night, receiving a lacerated and contused wound of his hand which necessitated amputation of the index finger. He was invalided from the service after 13 days on the sick list.

Hatch cover improperly secured.—The cover fell on a man's foot. The resulting contused wound required 12 days' treatment on the sick list.

Hatch cover improperly secured.—The cover fell on a foot causing fracture of the great toe, requiring 45 days' treatment on the sick list.

Unguarded open ladder way.—Through negligence the ladder way was not roped off after the platform was removed. A man walked through the opening, fell, and sustained a contusion of the knee. He was on the sick list 14 days.

Inadequate illumination on deck.—An officer stumbled over a deck bitt, sustaining multiple contusions of the face. He was on the sick list six days.

Unguarded manhole.—A man, temporarily blinded by bright lights, fell through the open unguarded manhole, sustaining contusion of the leg by which he was disabled for six days.

Unguarded bunker hole.—The plate had been removed and the hole was left unguarded by a man working in the bunker. Another man stepped into the hole. He received a lacerated wound of the leg and was disabled 16 days.

Unsafe practice; failure to shut down ventilation blower before cleaning.—Result: Lacerated wound of a toe; 16 sick days.

Unsafe practice with rotary saw.—A carpenter's mate worked with a rotary saw while wearing a gauze bandage on one of his fingers. The bandage was caught by the saw and his hand was drawn in the path of the saw. He was on the sick list 27 days.

Unsafe practice with joiner machine.—A bandage on the operator's finger caught in the machine and drew his hand against a blade. He received a lacerated wound of the finger and was on the sick list 11 days.

Unsafe practice with joiner machine.—The sleeve of the operator's jumper caught in the machine. Result: Lacerated wound of the hand; 11 sick days.

Negligence in leaving lye water in a coffee pot.—A man drank some of the lye water, thinking the pot contained coffee. Chemical burns of the mouth and throat resulted. He was kept on the sick list two days.

Gasoline, improper use of.—Gasoline was used instead of kerosene to light an oil range. An explosion resulted and one man sustained severe burns of both legs which incapacitated him for 23 days.

Kerosene, carelessness in the use of.—A man wiped paint from his face and hands with kerosene. Fifteen minutes later he lighted a match. Kerosene was still present. It ignited, causing burns of face and hands. He was on the sick list nine days.

Gasoline, careless handling of.—A man permitted his hand to become wet with gasoline while preparing to light a blow torch. When he lighted a match the gasoline ignited. He was on the sick list nine days because of the resulting burn.

Lye water carelessly left on bathroom floor.—A man received severe chemical burns of both feet when he stepped into a strong solution of lye that had been left on the floor of a shower bath compartment. The victim of negligence was disabled six days.

Chain hoist not properly blocked.—The hoist ran off its runner and fell on a man's head. Result: Lacerated wound of scalp; 22 sick days. The accident was attributed to negligence on the part of another person.

Coaling gear; defective material.—Because of a defective sheave pin, a coaling block broke open and released a wire cable which struck two men. One man sustained an abrasion of the chest. The other sprained his hip. Each was on the sick list three days.

Defective guard rail on board a destroyer.—The defective rail carried away while at sea. One man was washed overboard. He was rescued, but in falling he received a lacerated wound of the head which disabled him for 10 days.

Unguarded shaft in a motor dory.—A man's foot was caught by the shaft coupling and a fracture resulted. The man was disabled for 37 days. The accident was ascribed to lack of a safety device.

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